ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXIV, No. 13.

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The fast run from New York to Buffalo made over the New York Central R. R. on Sept. 11, was somewhat faster than noted in our issue of Sept. 12, the entire run of 436½ miles having been made in 412 minutes (5:40:30 a. m. to 12:32:26 p. m.), or at the rate of 63.57 miles per hour throughout, including all stops. Only two stops were made, at Albany and Syracuse, occupying 1 m. 35 secs. and 2 m. 25 secs. respectively. The train was made up of four cars, weighed 361,000 lbs. (including passengers and supplies), and had a carrying capacity of 218 passengers. Including the engine and tender, the train was 337 ft. long, and weighed 565,000 lbs. The engines used on this run was as follows: New York to Albany, No. 870; weight, 201,000 lbs.; engineman, A. Buchanan; fireman, A. Elliott. Albany to Syracuse, No. 999; weight, 204,000 lbs.; engineman, Edward Chase; fireman, J. Starke. Syracuse to East Buffalo, No. 903; weight, 202,000 lbs.; engineman, Charles Hogan; fireman, John Elmore. All the engines are of the eight-wheel type. No. 999 was described in our issue of May 18, 1893. Two engines were used on the steep grade (90 ft. to the mile) from Albany to West Albany. We have discussed this remarkable run in our editorial columns.

A test of the hauling capacity of the electric cars on the Nantasket Beach branch of the New York, New Haven & Hartford R. R. was made recently, in which one of the cars proved capable of starting and hauling a train weighing about 175 tons. Another car, equipped with four motors, and having a load of 5,000 lbs. placed over the trucks, to increase the adhesion, hauled 12 cars, weighing 400 tons, but became stalled when two more cars were attached. Two electric cars, one with four and the other with two motors, were then coupled together, and hauled 30 cars, weighing about 950 tons but during this run there was a blow-out of a fuse, which put a stop to the test. Fast runs with single cars were also made, and speeds of 75 miles per hour are said to have been reached.

The most serious railway accident of the week was a head collision of passenger trains at Melby, Minn., on the Great Northern Ry., Sept. 11. The trains are scheduled to pass at Ashby, at 1:25 a. m. but the eastbound train had run past that place, as the westbound train was late. Both engines were wrecked, and also the mail and express cars, five men being killed (including both enginemen, one fireman, a mail clerk and an express messenger), and about twelve persons were injured.

A rear collision of electric cars on the elevated railway of the North Hudson County Elevated R. R. occurred at the Henderson St. station, Hoboken, N. J., Sept. 13. The cars were running fast and, it is said, too close together. The first car over-ran the station, and the motorman of the second car thought it was not going to stop and did not slow down. Two persons were injured.

An explosion in the works of the American Smokeless Powder Co., at Baychester, N. Y., on Sept. 14, killed three persons.

A violent storm of wind and rain occurred Sept. 11 at Cape Vincent, N. Y., and the shed of the railway station was blown down, falling upon a crowd of excursionists, who were taking shelter. Two persons were killed and 15 injured, some seriously.

The straightening of the four tracks of the New York, New Haven & Hartford R. R. at Greenwich, Conn., has been completed and the new line put in service. The new tracks were laid and the station moved to its new position on foundations already prepared before any change in service was made, and on a Sunday the connections were made at each end, and the old tracks abandoned. The length of new track is about a mile.

The collision on the Sea Beach Railway, noted in our issue of Sept. 5, resulted in the death of one man, and the verdict of the coroner's jury was to the effect that the railway company was criminally negligent in failing to provide a proper signal system or telephone or telegraph communication between its stations. The employees of the company were exonerated from blame.

The Cotton States & International Exhibition at Atlanta, Ga., was formally opened Sept. 18, and will remain open until the end of December.

Oil engines and air compressors are being tried by the U. S. Lighthouse Board for sounding the fog sirens on lightships, in view of the promptness with which the apparatus can be put to work as compared with the time consumed in getting up steam of sufficient pressure. The Winter Quarter Shoal lightship, off Atlantic City, N. J., has been fitted with two of the Hornsby-Akroyd oil engines (for which the De La Vergne Refrigerating Co., of New York, has the agency), and a Clayton air compressor. With this plant the necessary pressure can be obtained in 5 minutes, while lighting the fire and getting up steam for a steam siren consumes 30 to 45 minutes, so that the fog may have become very dense before the fog siren can be sounded. The oil consumption would be very much more economical than coal consumption.

Light equipment for suburban trains is being tried on the Chestnut Hill branch of the Pennsylvania R. R. The cars have the seats arranged as in the cars of the New York elevated railways, and accommodate 48 persons each. Tank engines will replace the ordinary eight-wheel engines with tenders. This is a reasonable and economical step which has already been taken by some other roads, and we have more than once commented upon the advantages of tank engines for this class of service, in which they are almost always used on English railways.

The submerged steel intake of the water-works of Toronto, Ont., recently made its appearance on the surface of the bay at two points. The upper portion of one of the flanged joints of the floating pipe opened about 2 ft., necessitating breaking the balance of the joint before the pipe could be lowered. In the winter of 1892 a somewhat similar accident occurred at Toronto, the pipe breaking through the ice.

The water-works of Kansas City, Mo., are now owned by the city, the National Water-Works Co. having turned them over on Sept. 1 for $3,000,000. This action ends a long legal fight between company and city. There were in the United States at the last census 28 cities having over 100,000 population, and this transfer leaves only five of the cities dependent upon private companies for their supply. These five cities, with their populations in 1890, are as follows: San Francisco, 298,997; New Orleans, 242,039; Omaha, 140,452; Denver, 106,713; Indianapolis, 105,436. Small sections of Chicago and Brooklyn, and a considerable portion of Pittsburg are supplied by private companies, and the Louisville Works are nominally owned by a company, although actually owned by the city.

Legal action to compel steps to prevent the electrolysis of water mains in Omaha has been instituted by the representatives of the American Water-Works Co. The action has been brought in the Federal court against the Omaha Street Ry. Co. in the form of a request for an order to compel the adopting and carrying out of some method of preventing the action of electric current upon the water mains, with the alternative of an injunction against the operation of the street railways.

The Parsons steam turbine, which has been in successful use in English electric lighting stations for some years, is about to be manufactured in this country by the Westinghouse Machine Co., which has secured all American rights in the invention. The shaft of the turbine drives the armature of an electric generator. The machine was described and illustrated in our issue of Feb. 27, 1892.

Municipal ownership of street railways and of electric railway and lighting plants is making steady progress in Great Britain. According to a letter in the New York "Tribune," Manchester, Oldham, Huddersfield, Bradford, Glasgow, Brighton, and other cities, have established electric lighting plants under municipal ownership and management. In Glasgow and Manchester this policy has been markedly successful. In Bradford a return of 10% has been made to the town treasury upon the capital invested, after payments have been provided for the sinking fund. In many English and Scotch cities the municipal government retains control over the roadway, constructs and owns the tramway, and either operates it as a branch of the town service or leases it to the highest bidder with guarantees of remunerative rentals, low fares and satisfactory accommodation for the public. In Leeds, the Town Council purchased the property of the street car lines—horses, engines, cars and stations—for $650,000, and brought them under direct municipal management. The wages of the operatives were advanced, and their working hours were shortened. Fares were reduced, the rolling stock was improved, and the traffic enormously increased. There is a strong movement in rural communities for the construction of light or electric railways at the expense of ratepayers for the benefit of the farming classes, and Parliamentary legislation is eagerly awaited for that purpose.

The foundations for the Cathedral of St. John the Divine, in New York city, now being constructed, contain some 13,000 cu. yds. of concrete, and 5,000 cu. yds. of dimensioned granite masonry. This building will be 520 ft. long and 200 ft. wide and will have a tower 445 ft. high, and the foundations referred to are those for the tower and adjacent choir. The main tower rests on arches sprung from four smaller corner towers, and each of the smaller towers transmits an estimated pressure of 17,000 tons to the bed of concrete 38 ft. square, which supports its base. The concrete footing rests on solid rock and is rammed in horizontal, 10-in. layers with 20-lb. rammers. The concrete is composed of 1 part Portland cement, 2 parts sharp sand, and 3 parts quartz gravel, 1½ ins. to 2 ins. large, from Port Eaton on Long Island. The concrete is mixed by machine and deposited quite dry. When stopping work for the night, the top layer is terminated with a long sloping edge, and in the morning this is plastered with a mortar of 1 cement to 2 sand before the concrete work is resumed. A very solid homogeneous mass is thus obtained. The foundation work is being done by Sooysmith & Co., of New York, with General Wm. Sooysmith, M. Am. Soc. C. E., of Chicago, as Consulting Engineer.

The use of mechanical car-dumping appliances, such as are used at some of the lake ports is said to be contemplated for the furnaces of the Carnegie Steel Co. and other large steel works at Pittsburg, Pa. By hand labor, or even by improved dump cars, there is considerable delay in the handling of the enormous quantities of ore consumed at these works, and some radical change is therefore contemplated. A car-dumping device used at Ashtabula, O., was illustrated in our issue of Sept. 13, 1894.

The Committee of Awards of the Columbian Exhibition has reported that out of about 250,000 exhibits and 65,422 exhibitors there were but 23,586 awards. It is claimed that this is a smaller percentage of exhibits receiving awards than prevailed at any previous international exposition. With a non-competitive system of awards the fear was originally expressed that there would be such an excess of awards as to cheapen their value; but although the judges were left free to grant as many awards as they saw fit the result has been the reverse of that expected. The medals and diplomas are not yet ready for distribution; and while the committee regrets this delay it lays the blame to the Treasury Department.

A large bucket dredge for work at the port of Libau, Russia, is fitted with a pulverizer, in which the tenacious clay and marl dredged up are reduced to liquid mud by revolving steel arms and a water jet, so that it can be pumped ashore through pipes by a centrifugal pump. The dredged material can also be discharged by shoots into barges in the usual way, or into side hoppers in the hull of the vessel. The dredge is 180 ft. long, 35 ft. beam, and 14 ft. deep, and is fitted with twin-screws driven by compound condensing engines of 800 I. HP., giving a speed of 7 knots per hour. One of these engines also works the dredging plant and pulverizer, while the other works the centrifugal pump and the hauling winches. Steam is supplied by two steel boilers at 100 lbs. pressure, either boiler alone being able to work the dredging machinery to its full power. The vessel is lighted by electricity. The buckets can lift about 600 tons of material per hour, and the machine has records of 6,000 tons in a working day, and 62,700 tons a month, raised and deposited. The dredge was built for the Russian government by William Symons & Co., of Renfrew, Scotland, who have built four other dredges for the same port.

The Correspondence School of Technology, at Cleveland, O., which has been now carried on for two years, has proved so successful an enterprise that it has recently been incorporated, and additions have been made to its corps of instructors and to the courses offered. Mr. Wm. H. Searles, M. Am. Soc. C. E., and Mr. E. C. Cooke are among the recent additions to the faculty. The new courses of instruction include the subjects of hydraulic engineering, mechanical engineering, and advanced mathematics. Mr. E. P. Roberts is President of the school, Mr. J. C. Gallup is Secretary, and Mr. Thomas Robinson is Treasurer.

CAR TRANSFER BRIDGE AT WEST NORFOLK, VA.; ATLANTIC & DANVILLE R. R.

Car ferries are very commonly used for the transfer of railway cars at harbors from the railway piers to private docks and yards, and also for transferring trains across rivers and the great lakes to connect certain railways forming through transportation routes. In order to transfer the cars from the pier to the barge or steamer, a hinged bridge is necessary, with means for adjusting the free end to coincide with the level of the track on barges of different heights and at different stages of the tide. This adjustment is effected by means of chains passing over pulleys in the top of a gallows frame over the free end of the bridge. Such bridges may be divided into two classes: the first having a pontoon under the end, and the second being supported entirely by the chains, the latter being in many ways preferable. The accompanying cuts represent a bridge of the latter type, built at West Norfolk, Va., for the terminal improvements of the Atlantic & Danville R. R., and we are indebted to Mr. Philip Aylett, who was Resident Engineer on the work, for drawings of the structure.

The bridge is situated about 450 ft. from the shore, being approached by a timber trestle over a sandy flat, which is bare at low tide and covered with about 3 ft. of water at ordinary high tide. The outer end of the bridge is 250 ft. from the channel of the eastern branch of the Elizabeth River, and 200 ft. from the Port Warden's line. By this arrangement the dredging of a ferry slip 700 ft. in length was avoided. The present slip is 250 ft. long, 50 ft. wide at the end of the bridge, and 150 ft. where it meets the channel. About 40,000 cu. yds. of material were dredged, giving a depth of 13 ft. of water at low tide. The fender and guide piling extend along both sides of the slip from the gallows frame to the Port Warden's line.

The approach trestle has bents 14 ft. c. to c., each bent having three piles 4 ft. apart, except that at about 170 ft. from the bridge the trestle widens out for two tracks, the main track being carried straight on to the bridge, and the second track turning out from the main track, the point of the switch being 170 ft. from the pivot pins of the bridge. The turnout curve is 17° and 56.5 ft. long, then reversing and entering a tangent 13 ft. from center of main track by a curve of 9° 29' and 98.6 ft. long. This arrangement gives a minimum length of siding and 15 ft. of tangent before entering the bridge, but an easy turnout is of more importance than a short siding. The bents have caps 12 × 12 ins., which carry stringers 8 × 15 ins. and 28 ft. long, upon which are laid the ties. In order to shorten the trestle approach, the shore end is on a 10° curve for a distance of 200 ft., the outer rail being elevated by 3-in. raising blocks. The trestle piles and abutment piles are of unbarked cypress, the former ranging from 30 ft. to 50 ft. in length, according to the nature of the soil penetrated, and the latter 50 ft. long, 18 ins. diameter at the butt and tapering to 8 ins. The foundation piles for the gallows frame are of creosoted pine, 50 ft. long. The piles for the abutment and the gallows frame have 12 × 12-in. creosoted Georgia pine caps, drift bolted to each pile. Virginia yellow pine ties treated with 8 to 10 lbs. of creosote per cu. ft., are used in the foundation for the gallows frame, and the frame itself is of Georgia pine. The heads of piles and all joints between caps, etc., are thoroughly coated with creosote.

The arrangement for adjusting the height of the free end of the bridge is novel, and is specially designed to provide for the irregular loading of the bridge by a car on one track only, which thus depresses one side of the bridge more than the other. For this purpose each side of the end is counterbalanced independently. Thus, in the cross-section, Fig. 2, the cable secured to a block on the top of the gallows frame by a U-bolt at A, passes down to the geared pulley B, across the bridge (passing through 6-in. holes in the web plates of the girders), round a loose pulley opposite B, and then up to the 46-in. loose pulley C on the gallows frame, and down to the counterweight D. About a foot behind this cable is another, secured to the top of the gallows frame by a U-bolt at E, passing round the geared pulley F, across the bridge (through holes 11 ins. from the center of those for the other cable), round a loose pulley opposite F, and then up to the loose pulley G on the gallows frame and down to the counterweight H. The wheels C and G are set at an angle, so that the cables clear each other, as shown in Fig. 3. The friction of each cable on its geared wheel is such that either side of the bridge can be raised or lowered by turning the hand gearing, so that the bridge tilts sideways with the opposite geared pulley as a pivot. In use the gearing is free to revolve under any force exerted at the end of the bridge resting on the barge. The arrangement of the gearing is shown in Fig. 4.

The two counterweights are equal to half the suspended weight of the bridge, their weight aggregating 50,000 lbs. to balance 100,000 lbs. of suspended weight, and by the gearing the counterweights are made to exactly balance the bridge, so that the same amount of power is required to lower as to raise the end. The bridge will thus remain

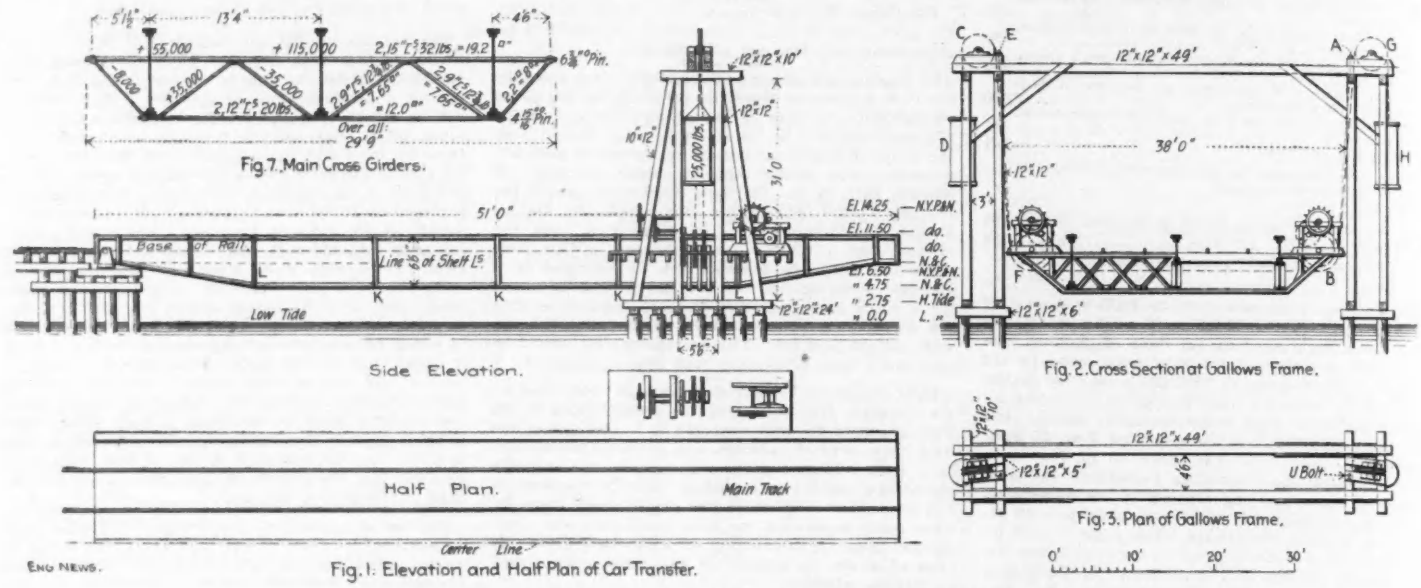
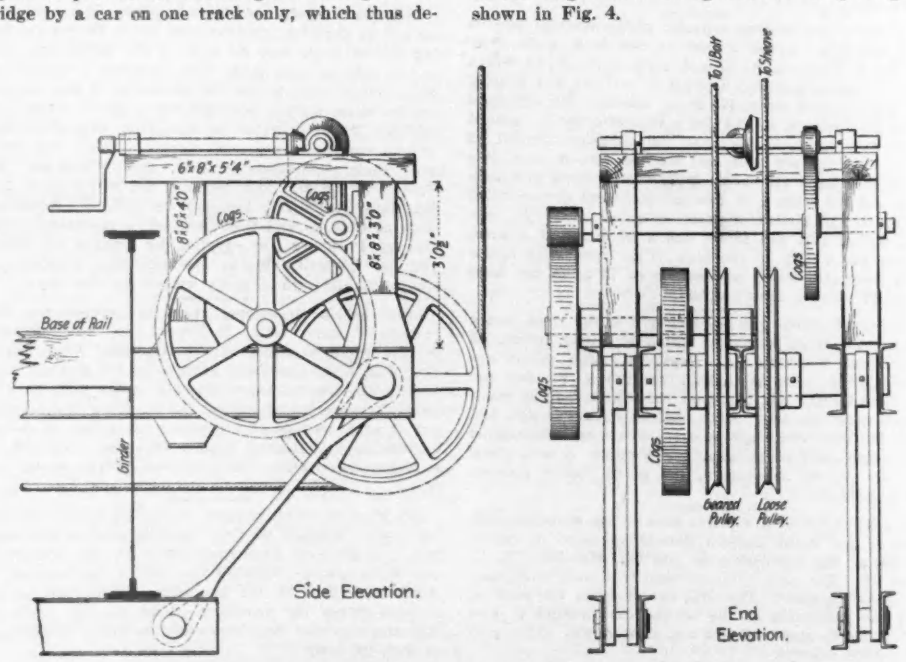
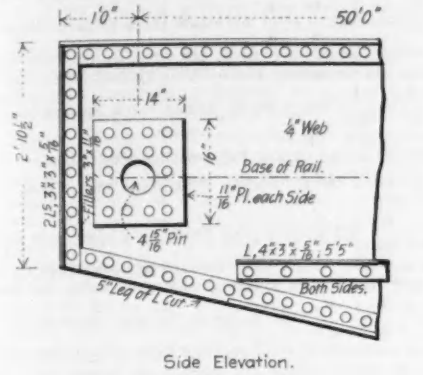


Fig. 7. Main Cross Girders.
Side Elevation.
Half Plan.
Fig. 1. Elevation and Half Plan of Car Transfer.
Fig. 2. Cross Section at Gallows Frame.
Fig. 3. Plan of Gallows Frame.
TRANSFER BRIDGE FOR CAR FERRY; ATLANTIC & DANVILLE R. R.



in any position to which it is adjusted, and when the barge is loaded it can be withdrawn without any further adjustment of the bridge by the gearing. Each counterweight is a cylinder 3 ft. 6 ins.



Details of Bearings for End Pins.

Fig. 5. Pivot Bearings and Pivot End of Main Girders.

inside diameter, of three courses of ¼-in. plate and a dished bottom of 7-16 in. plate, all put together with ⅝-in. rivets. The bottom has a small hole for drainage. The total height is 14 ft. 10½ ins. Inside cross-plates near the top of the cylinder carry the 1¾-in. U-bolts, 30 ins. long, to which is attached the iron loop of the hoisting cable. These cables are of 1¼ ins. diameter, of cast steel wire, and are 119 ft. long over the loop ends.

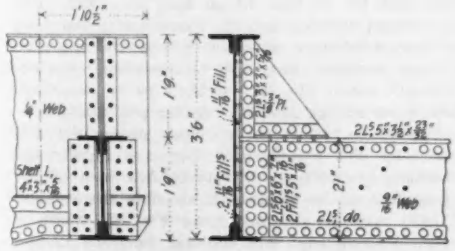


Fig. 6. Outer End of Main Girders.

By means of the gearing the bridge can be adjusted to any ordinary barge, whether level or careened, and the various heights of barges used in connection with this transfer are shown in Fig. 1, the New York, Philadelphia & Norfolk R. R. having barges of three different heights, and the Atlantic & Danville R. R. having its barges so constructed as to be even with the bridge track when the bridge is level longitudinally. The free end of the bridge has a range of movement of 10 ft.

The bridge consists of three plate girders, 51 ft. long, or 50 ft. long from the pivot pins to the outer end, 6 ft. 6 ins. deep, and spaced 13 ft. 4 ins. apart c. to c. They are designed for a dead load of 600 lbs. per lin. ft., and a live load of 1,500 lbs. per lin. ft. The maximum bending stress is equal to 25,500,000 inch-pounds, and the fiber stress is 9,600 lbs. per sq. in. Each girder is built up of 8 chord plates, 9-16 × 12 ins.; 4 chord angle irons, 23-32 × 5 × 3½ ins., weighing 18 lbs. per ft., and one web plate, ¼ × 78 ins. At a depth of 2 ft. 9 ins. below the top chord are longitudinal shelf angles 5-16 × 4 × 3 ins., riveted to one side of the web plate of each outer girder and to both sides of the middle girder, these angles carrying the ties. At the shore or pivot end the depth of

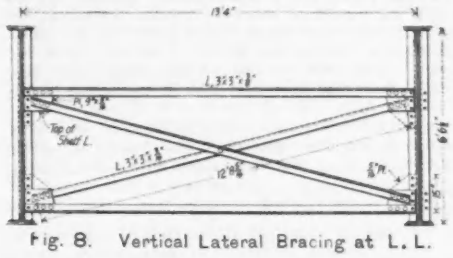


Fig. 8. Vertical Lateral Bracing at L. L.

the girders is reduced to 2 ft. 10½ ins., and each girder has a horizontal pivot pin 4 15-16 ins. diameter and 5⅜ ins. long at the bearing, with a neck 4 ins. diameter and 1½ ins. wide at each end, and each pin having two 4-in. Lomas nuts. The pins and bearings are shown in Fig. 5. At the outer end the girders are 3 ft. 6 ins. deep, connected by a plate girder, as shown in Fig. 6.

There are two main cross-girders of the form shown in Fig. 7, which are spaced 4 ft. 6 ins apart, and carry the gearing. An extension of the upper members of these girders, 5 ft. 1½ ins. long, is riveted to the outside of the outer main girders, and carries the platform for the machinery. The lifting power is transmitted directly to the lower members of these cross-girders (which members are under the bottom chords of the main girders) by means of eyebars 2 ins. square, having looped ends which embrace 6¾-in. pins in the upper members and 4 15-16-in. pins in the lower members. The gearing for the barge connections is supported upon four ties, which project through apertures 8 ins. wide, 12 ins. high and 24 ins. apart, cut in the webs of the outer main girders. The toggle bars and barge connections are so arranged that any motion of the barge, whether horizontal or vertical, is communicated to the bridge. The latches are bars 5 ins. square, moved by means of a hand wheel and gearing.

The necessary flexibility of the bridge to withstand the effect of the barges careening when loaded on one side only, is provided for by placing the lateral bracing in the neutral axis of the main girders. Secondary stresses are thus avoided, and any given cross-section remains rectangular, while considerable freedom to twist is allowed. At the three panel points marked K, K, K, on Fig. 1, are horizontal, transverse angles ⅝ × 3 × 3 ins., level with the shelf angles, while at the two panel points marked L, L, is the vertical transverse bracing shown in Fig. 8. In the five panels formed by K, K, K, and the top chords of L, L, is the horizontal diagonal bracing, consisting of angles 5-16 × 3 × 3 ins., with 5-16-in. junction or intersection plates.

The superstructure was designed by Mr. Charles C. Wentworth, M. Am. Soc. C. E., and the terminal improvements (including this structure) were constructed under the supervision of Mr. W. B. Causey, Engineer of Maintenance of Way of the railway. Mr. Philip Aylett was Resident Engineer in charge of construction, and Mr. Jos. Causey was Assistant Resident Engineer. The superstructure was built at the works of the American Bridge & Iron Co., Roanoke, Va. Messrs. Rutherford & Brown, of New York, were the contractors for the piling and dredging, the Delaware Construction Co., of Wilmington, Del., being the subcontractor.

TRUE ECONOMY IN THE DESIGN OF BRIDGES.*

By J. A. L. Waddell, M. Am. Soc. C. E.

Treatise after treatise has been written upon the subject of economy in superstructure design, but unfortunately the result is simply a waste of good mental energy; for the writers thereof invariably attack the problem by means of complicated mathematical investigations, not recognizing the fact that the questions they endeavored to solve are altogether too intricate to be undertaken by mathematics. The object of each investigation appears to have been to establish an equation for the economic depth of truss, or that depth which corresponds to the minimum amount of metal required for said truss; and, to start the investigation, it seems to have been customary to make certain assumptions which are not even approximately correct. For instance, the principal assumption of several treatises in French and English is that the sectional area of each member of a truss is directly proportional to its greatest stress; or, in other words, that, in proportioning all members of trusses, a constant intensity of working stress is to be used, while in reality, for modern steel bridges, the intensities vary from, say, 6,000 lbs. up to 15,000 lbs., or, when wind stresses are considered, up to even 20,000 lbs. Again, no distinction is made between tension and compression members and the greatly varying amounts of their percentages of weights of details.

There is, however, one mathematical investigation concerning economic truss depth which, in the author's opinion, is approximately correct, and which is based on assumptions that are very nearly true; but it holds good only for parallel chords. It is this: Let A = weight of the chords, B = weight of the web, C = weight of the truss, and D = depth of the truss, then C = A + B.

FIG. 9. VIEW OF TRANSFER BRIDGE AND TRESTLE AT WEST NORFOLK, VA.; ATLANTIC & DANVILLE R. R.

But the weight of the chords varies inversely as the depth, or $A = \frac{a}{D}$, and the weight of the web varies directly as the depth, or B = b D, where a and b are constants; and therefore

$$C = \frac{a}{D} + b\,D.$$

If C is to be made a minimum, we shall have, by differentiation, $\frac{d\,C}{d\,D} = -\frac{a}{D^2} + b = 0$, or $-\frac{A}{D} + \frac{B}{D} = 0$ or A = B. As the second differential coefficient, after substitution according to the usual method for maxima and minima, comes out positive, the result obtained corresponds to a minimum. From this it is evident that, for trusses with parallel chords, the greatest economy of material will exist when the weight of the chords is equal to the weight of the web. The author

* This paper is to constitute Chapter III. of a work now in preparation by the author, entitled, "The Detailing of Steel Bridges." Copyright, 1895, by J. A. L. Waddell.

has verified this conclusion by checking the weights of chords and webs in a number of finished designs, finding it to be absolutely reliable. However, it is not of much practical value, because the economic depths of trusses with parallel chords are pretty well known, and again, when spans are much in excess of 200 ft., the chords are no longer made parallel. Moreover, the best depth to use is not often the one which gives the least weight of metal in the trusses.

The author finds by experience that for trusses with curved or broken top chords the economic depths, as far as weight of metal is concerned, are generally much greater than certain important conditions will permit to be used. For instance, especially in single track bridges, after a certain truss depth is exceeded, the overturning effect of the wind pressure is so great as to reduce the dead load tension on the windward bottom chord to such an extent that the compression from the wind load, carried by the lower lateral system, causes reversion of stress; and such reversion eyebars are not adapted to withstand. Again a very deep truss requires an expensive traveler, consequently it would be really economical to reduce the depth of both truss and traveler, and increase the total weight of metal in the trusses; especially considering that the adoption of a truss depth several feet less than the theoretically economic one increases the total weight of metal but slightly.

Again, the total cost of a structure does not vary directly as the total weight of metal, for the reason that an increase in the sectional area of a piece adds nothing to the cost of its manufacture, and but little to the cost of erection; so it is only for raw material and freight that the expense is increased. For these reasons truss depths considerably less than those which correspond to the minimum amount of metal are generally the best ones to use. For parallel chords the theoretically economic truss depths vary from one-fifth of the span for spans of 100 ft. to about one-sixth of the span for spans of 200 ft.; but for modern railway bridges the least allowable truss depth is about 28 ft., unless suspended floor beams be used, a detail which is rapidly going out of fashion.

In two 500-ft. spans of a combined railway and highway bridge which the author is now building, he has employed a truss depth of 72 ft., but this was determined by the reversal of stress in bottom chords through wind pressure. A greater depth, if permissible, would have caused a saving in total weight of metal.

In a design of the author's for a 560-ft. span, a truss depth of 90 ft. was adopted, but in this case the live load was very great, varying from 10,000 lbs. per lin. ft. for short spans to 8,000 lbs. per lin. ft. for long spans; and the bridge is 20% wider than in the case of the two 500-ft. spans just mentioned. The greater the live load, and the wider the bridge, the greater can the truss depth be made advantagously.

The little mathematical investigation given above can be applied with advantage to plate girder bridges and to the floor systems of truss bridges. If, for ordinary cases, in designing plate girders, one will adopt such a depth as will make the total weight of the web with its splice plates and stiffening angles about equal to the weight of the flanges, he will obtain an economically designed girder, and a deep, stiff one. For long spans, however, this arrangement would make the girders so deep as to become clumsy and expensive to handle, consequently when a span exceeds, say, 40 ft., the amount of metal in the flanges should be a little greater than that in the web; and the more the span exceeds 40 ft., the greater should be the relative amount of metal in the flanges to that in the web.

Concerning economical panel lengths, it is safe to make the following statement: "Within the limits set by good judgment and one's inherent sense of fitness, the longer the panel the greater the economy of material in the superstructure." Of course, when one goes to such an extent as to use a 30-ft. panel in an ordinary single track bridge, he exceeds the limits referred to; because the lateral diagonals become too long, and their inclination to the chords becomes too flat for rigidity. Again, an extremely long panel would often cause the truss diagonals to have an unsightly appearance, because of their small inclination to the horizontal.

There is another mathematical investigation which is of practical value. It relates to the economic lengths of spans, and was first demonstrated in print by the author about five years ago in "Indian Engineering," although the principle was announced some three years earlier, in the first edition of his "General Specifications for Highway Bridges of Iron and Steel." Strange to say, many engineers failed to see any difference between this principle and an old practice of forty years' standing. The principle is that "for any crossing, the greatest economy will be attained when the cost per lin. ft. of the substructure is equal to the cost per lin. ft. of the trusses and lateral systems." The old practice was, to make for economy the cost of a pier equal to the cost of the span that it supports, or more properly, equal to one-half of the cost of the two spans that it helps to support.

Is not the difference between these two methods perfectly plain? In one the cost of the pier is made equal to the cost of the trusses and laterals, and in the other it is made equal to the cost of the trusses, laterals, and the floor system. When one considers that the cost of the floor system is sometimes as great as one-half of the total cost of the superstructure, he will recognize how faulty the old method was.

The following is the demonstration of the principle, simplified to the greatest practicable extent. Let us assume a crossing of indefinite length, for which the depth of bedrock is constant, and let S = cost per lineal foot of the substructure, T = cost per lin. ft. of the trusses and laterals, F = cost per lineal foot of the floor system, B = cost per lineal foot of the entire bridge and L = length of span; then $B = S + T + F$.

Now if we assume that slight changes in lengths of span will not affect materially the sizes of the piers, the cost per ft. of the substructure will vary inversely as the span length, or $S = \frac{s}{L}$, s being a constant.

Again, the cost per foot of the trusses and laterals, for slight changes in length of span, varies nearly directly as the span length, hence we may write the equation $T = t\,L$, t being a constant.

The cost per foot of the floor system is practically independent of the span length, being a function of the panel length, which does not change materially with the span. We now have the equation

$$B = \frac{s}{L} + t\,L + F$$

in which B is to be made a minimum. Differentiating, we have (as F is a constant) $\frac{d\,B}{d\,L} = -\frac{S}{L} + \frac{T}{L} = 0$, or $S = T$. A further differentiation shows that the result corresponds to a minimum.

This proves that in any layout of spans the greatest economy will be attained when the cost of the substructure per lineal foot of bridge is equal to the cost per lineal foot of the trusses and lateral systems. Of course, no such thing as a bridge of indefinite extent ever exists, nor is the bedrock often level over the whole crossing; nevertheless the principle can be applied to each pier and the spans that it helps to support by making the cost of said pier equal to one-half of the total cost of the trusses and laterals of both spans. Since working out this demonstration, some eight or nine years ago, the author has made a practice of checking the correctness of the principle thereby established by comparing the cost of substructure and superstructure in a number of bridges which he has designed and built, with the result that he finds the principle to be exact. Some engineers have claimed that it cannot be so because of errors in the assumptions. It is true that these errors exist; but, in the first place, they are small, and, in the second place, they tend to balance each other.

The principle will apply also to trestles and elevated roads. In the latter, if we make the cost of the stringers or girders of one span equal to the cost of the bent at one end of same, including its pedestals, we shall obtain the most economic layout. In an ordinary railroad trestle, consisting of alternate spans and towers, it will be necessary for greatest economy to have the cost of all the girders in two spans (one span being over the tower), plus the cost of the longitudinal bracing of one tower, equal to the cost of the two bents of said tower, including their pedestals.

On page 235 of the first edition of Prof. J. B. Johnson's "Theory and Practice of Modern Framed Structures," Mr. Bryan uses this method of the author's, in a slightly different form, for determining the most economic number of spans to adopt at any crossing, establishing the equation

$$y = A + B + (x - 1)\,C + l\,\frac{a\,l}{b\,x}\,p.$$

in which y (the total cost of bridge) is a minimum when

$$\frac{l}{x} = \sqrt{\frac{b}{a\,p}}\,C;$$

where

A = cost of the two end abutments in dollars;
B = cost of the floor and that part of the iron weight which remains constant, in dollars;
C = cost of one pier, in dollars, assumed as constant;
l = length of bridge in feet;
x = number of spans;
p = price of iron per pound, in dollars;
y = total cost of bridge, in dollars;
a = weight per foot of a span of b feet in length.

Thus far, all right, but then he makes an assumption which will not be correct except for one live load, for one set of specifications and for single track railway bridges, viz., that for pin-connected spans $\frac{b}{a} = \frac{1}{5}$.

Consequently his subsequent table of economic span lengths is not in any sense general, but is true only for single track bridges designed for one standard live load and according to one standard set of specifications; while his equations hold good for bridges of any kind and loading, including highway as well as railway structures.

As a check on the correctness of Mr. Bryan's assumption that $\frac{b}{a} = \frac{1}{5}$ for single track bridges, the author has looked up some of his latest designs and has found the following: For a 375-ft. through span, Class X, $\frac{b}{a} = \frac{1}{5.7}$; for a 362-ft. double track through span, Class Z, $\frac{b}{a} = \frac{1}{9.7}$, and for a similar 490-ft. span, $\frac{b}{a} = \frac{1}{9.0}$; for a 280-ft. double track deck span, Class Y, $\frac{b}{a} = \frac{1}{9.1}$, and for a similar 200-ft. deck span $\frac{b}{a} = \frac{1}{9.5}$. For a single track 200-ft. through span designed by a contracting bridge company and checked by the author, $\frac{b}{a} = \frac{1}{4.7}$; the detailing thereof, however, was ultra economical. It is but fair to state that the 375-ft. and 362-ft. spans are about 2 ft. wider than the ordinary single track bridges of such span lengths. This causes the denominator of the fraction to increase. It is evident, though, that assuming any fixed value for $\frac{b}{a}$ is unwarranted, because the weights per foot of trusses and laterals for spans of Classes Z and U, of the "Compromise Standard System of Live Loads for Railway Bridges," will vary by from, say, 33 to 40%; consequently the values of $\frac{b}{a}$ would vary likewise.

In cases of structures for crossings where there is danger from washout, it may be truly economical to use metal unsparingly in the design, in order to insure the metal work going together readily and with the least possible delay; and in extreme cases it would be eminently economical to adopt a cantilever design and thus reduce the risk of washout to a minimum by the expenditure of a considerable amount of extra metal for the superstructure.

There is another economic feature of design, which unfortunately has been overlooked continually—viz., that the most economic structure is the one for which the first cost, plus the capitalized cost of annual deterioration and repairs, is a minimum. A proper consideration of this economic feature would cause the use of better details, larger sections of main members, more efficient and rigid sway-bracing and a greater minimum thickness of metal.

THE CHICAGO MAIN DRAINAGE CHANNEL.

XVIII.

Sections 11, 12 and 13.

The contractors for these three sections of the channel are Mason, Hoge & Co., who were awarded the work on Sections 11 and 12 on July 13, 1892, and for Section 13 on July 27, 1892. For this reason, and because the character of the work and the machinery used are nearly the same on all three sections, they will be described together. Although nearly the last sections to be described, they were among the first to be put under contract, and as the work has been prosecuted diligently by the contractors, they are rapidly approaching completion. A pretty fair idea of the appearance of the work as it stood in the summer of 1895 may be obtained from Fig. 81, which is a view looking east and showing Sections 12 and 11 in the foreground, with Sections 10, 9 and 8 curving around toward the right in the distance. To the right of the main channel is shown a glimpse of the Illinois & Michigan Canal and the tracks of the Chicago, Santa Fe & California R. R., while the main channel can be traced to the horizon by the white line of the spoil banks.

The amount of work on these three sections and the prices paid for each class are as follows:

	Glacial drift.		Solid rock.		Ret'n'g wall.	
Sect'n.	Cu. yds.	P'ce, cts.	Cu. yds.	P'ce, cts.	Cu. yds.	Price.
11....	49,788	30¼	1,001,183	79¼	.....	....
12....	41,739	30¼	1,000,500	79¼	10,000	$3.50
13....	35,000	26	1,053,700	74¾	20,000	3.50
Total.	126,527	....	3,054,383	....	30,000	

Of the total 3,180,900 cu. yds. of excavation, practically all but 751,000 cu. yds. will be removed by Brown cantilever cranes exactly similar in construction to those described on Section 10. These machines have been operated by the manufactur-

ers, the Brown Hoisting & Conveying Machine Co., of Cleveland, O., the contractors paying this firm a certain price per cubic yard for removing the material after it was loaded into the skips.

Before taking up the work of these cranes a few words need to be said regarding the excavation done previous to putting them into operation. Altogether the glacial drift excavation amounted to only 126,527 cu. yds., and was merely the cleaning off of from 1 ft. to 2 ft. of earth overlying the rock. Teams, wheelbarrows and other ordinary methods of work were used and call for no especial mention. On Section 11, there was a considerable levee work done, and the contractors received an additional price for this. Such solid rock as was removed before the cranes began work was taken out with dump cars and cable inclines, with the usual tracks in the pit and on the spoil bank. Some very good work was done with the incline on Section 12. Two faces were worked, and the output per face per 10-hour shift averaged 322 cu. yds. for nine months worked in 1893.

Turning now to the work of the cantilever cranes, Table VI. shows the force worked, output and wages paid in operating the cranes on each section for the month of October, 1894. In submitting these figures, the Brown Hoisting & Conveying Machine Co. wrote:

> Enclosed find the blanks filled out for the month of October, 1894. This month was selected as one in which there were but very few interruptions, the contractors' men working nearly every day. We have assumed 27 ten-hour shifts for each machine, all of the cantilevers, excepting No. 7, working the greater portion of each day. The delays were on account of waiting for material, laborers, etc., and include the time lost by men not being on the work on account of rain and for other reasons. Cantilever No. 7 lost three full days while we were replacing a driving disk. For wages paid to laborers and foremen you will have to ask the contractors, as they are employed by them. ($3.00 per day for foremen; 15 cts. per hour for laborers.—Ed.) We put down the wages paid to the three men employed to operate the cantilevers. For coal we had to take the average for the month and then divide it by 27, the number of working days in the month, and assumed that as the average for the shift. The remainder of the figures will explain themselves.

TABLE VI.—Showing Amount of Rock Handled, Number of Employees and Wages of Employees for Cantilever Cranes Worked on Sections 11, 12 and 13 in October, 1894.

	Section 11.	Section 12.	Section 13.
No. 10-hour shifts in month	27	27	27
Cu. yds. exc. per crane per shift	544.4	488.8	541.5
No. skips worked on face	9	9	9
Av. skipload, cu. yds.	1.72	1.57	1.74
No. laborers and foremen on face	43	45	46
Cu. yds. exc. per man per shift	12.66	10.86	11.77
Pay of laborers, cts. per hour	15	15	15
Pay of foremen per shift	$3.00	$3.00	$3.00
Pay of crane engr. and fireman	$2.25	$2.25	$2.25
Pay of oiler for crane	$1.75	$1.75	$1.75
Pay of towerman or operator	$2.75	$2.75	$2.75
Tons of coal burned per shift	1.63	1.54	1.56
Cost of coal per ton	$1.73	$1.73	$1.73
Total hours' delay, all cranes	126	189	170

The figures in Table VI. are self-explanatory, with the exception, possibly, of those referring to delays. In operating a machine of this kind there are necessarily two causes of delay: (1) Accidents and small repairs to the crane itself, and (2) delays waiting for the skips to be loaded, blasts to be made and other waits on the excavating force. Dividing the figures of total delay of all cranes into these two classes of delay, for each machine the following results are obtained:

	Hours' delay in month due to crane.	Hours' delay in month due to contractors.
Crane 1, section 13	13	34
" 2, " 13	0.5	48
" 3, " 13	9	65.5
" 4, " 12	6	72
" 5, " 12	4	49.5
" 6, " 12	15.5	42
" 7, " 11	37	27
" 8, " 11	8.5	58.5
Total delay, eight cranes	93.5	291.5

These figures were furnished by the Brown Hoisting & Conveying Machine Co., and are for the month of October, 1894, only.

FIG. 81. GENERAL VIEW OF SECTIONS 12 AND 11, SHOWING CHARACTER OF ROCK CHANNEL AND PROGRESS OF WORK.

Table VII. has been compiled from the records of Division Engineer Mr. Charles L. Harrison, and shows the number of cranes worked on each section, the number of 10-hour shifts worked and the average output of each crane for 12 months.

TABLE VII.—Showing Number of Brown Cantilever Cranes Worked, Number of 10-Hour Shifts Worked, and Output per Shift for 12 Months, February, 1894, to January, 1895, Inclusive, on Sections 11, 12 and 13.

	Section 11.			Section 12.			Section 13.		
	No. cranes worked.	No. shifts worked.	Cu. yds. per shift.	No. cranes worked.	No. shifts worked.	Cu. yds. per shift.	No. cranes worked.	No. shifts worked.	Cu. yds. per shift.
Feb., 1894	2	44.4	306.4	2	44.5	359.6	4	91.3	346.1
Mar., "	2	39.7	372.8	2	50.5	455.4	4	95	443.2
April, "	2	41.2	526.7	2	41.5	506.0	4	90.5	540.3
May, "	2	49.5	391.9	2	43.1	394.4	4	85	489.4
June, "	2	55.8	491.0	2	50.3	447.3	4	109.4	488.1
July, "	2	53.8	553.9	2	51.7	566.7	4	109.6	514.6
Aug., "	2	81.8	440.1	2	51.1	514.7	4	113.7	468.8
Sept., "	2	48.8	627.1	2	47.3	539.1	4	96.3	396.7
Oct., "	2	49.6	502.7	3	76.9	514.9	3	78.6	558.5
Nov., "	2	45.6	541.7	3	69.8	485.7	3	64.7	420.4
Dec., "	2	38.6	707.2	4	74.1	530.4	2	38	605.3
Jan., 1895	2	41.4	490.4	4	83.7	494.6	2	33.9	471.7
Twelve months		590.2	494.6		684.5	480.1		1.006	472.2

Ingersoll-Sergeant and Rand drills are used, the number of each being as follows:

	Sec. 11.	Sec. 12.	Sec. 13.
Ingersoll-Sergeant	15	11	7
Rand	2	—	10

On Sections 11 and 13 air is supplied by 18 × 30-in. duplex Rand compressors, and on Section 12 two Ingersoll-Sergeant straight line air compressors are used.

The methods of drilling differ somewhat, not only on different sections, but sometimes on the same section. The holes are usually 12 ft. deep and drilled in a single row across the channel and about 8 ft. back from the face. The number of holes in a row varies, but generally it is either 16, 18 or 22. From two to three drills are used to put

in these holes, and one drill is worked on the large blocks.

Aside from the rock excavation already noted, the principal work on Sections 11, 12 and 13 has been the construction of a retaining wall on Sections 12 and 13. When work was begun it was not expected that much retaining wall would be needed, but as the excavation proceeded numerous pockets and seams of clay were found, which, when they broke into the sides of the channel, had to be filled with masonry. One of these pockets is shown in the right-hand wall about the middle foreground of Fig. 81. Often the pocket did not come to the surface within the limits of excavation, but appeared like the heading of a tunnel in the channel wall with a layer of solid rock above, as well as below, and on the sides. The pockets were sometimes globular in shape, and showed the marks of attrition, indicating that they were potholes worn by the action of water and boulders, and sometimes they appeared to be crevices or cracks in the bedrock. All were filled with clay which seemed to contain finely-ground limestone, and the mixture cut as smoothly and firmly as a cheese, and when burned gave a hard brick of a grayish white color, which took a very satisfactory polish. This property was taken advantage of by the laborers, who, in their idle moments, carved out various uncouth and heathenish beasts and baked them for ornaments. These clay pockets caused considerable trouble to the channeling machines, as will be noted further on, and added materially to the cost of the sections.

Cantilever Crane Work.—The conditions of the work on Sections 11, 12 and 13, together with the very complete records of output given in Table VII. enable a very satisfactory determination of the capacity of the cantilever crane on the canal work. The eight machines used on these three sections were all operated by the manufacturers after a nearly uniform system, and, it is fair to presume, in such a manner as to develop their best qualities. The figures of output cover an entire year's work for each machine comprising both winter and summer months.

Summarizing the figures of output, we find the average for each crane to be as follows:

	Sec.11. Cu.yds.	Sec.12. Cu.yds.	Sec.13. Cu.yds.
Av. output per 10 hrs. per crane	494.6	489.1	472.2
Av. output per man per 10 hrs...	11.5	10.86	10.26

Lumping together the work of all eight machines 1,107,300 cu. yds. of rock were taken out in 12 months, or 485.3 cu. yds. per 10-hour shift worked, or 10.87 cu. yds. per shift per man worked on the face. There were 306 working days in the year, or 2,448 working days for the eight machines, making the output per 10-hour working day 451.9 cu. yds.

The figures of delay cover but one month, but they may for various reasons be assumed to represent quite fairly the average delay per 10-hour shift for the year. Summarizing these figures, we get the following:

	1.	2.	3.	4.	5.	6.	7	8.
	Crane No.							
Hrs.' delay per ten hours	1.74	1.79	2.76	2.88	1.98	2.13	2.37	2.29

A delay of 2¼ hours per 10-hours may thus be expected for each crane, but of this delay only 0.43 hour is due to the machine itself, the remaining time being delays waiting for the skips to be loaded, for blasts, and for other purposes for which the crane is not responsible. It should be remembered that these delays are figured per working day, and not per day worked.

The cost of operating each crane per 10-hour shift is not easy to get at with exactness, but from the figures obtainable it seems to be about as follows:

Pay of engineer and fireman	$2.25
Pay of oiler	1.75
Pay of operator	2.75
Cost of coal	2.75
Laying track	.50
Cost of water, oil and waste	.25
Total	$10.25

The cost of repairs, a very important item, is not known, nor is it possible to know just what proportion of the expense of watchman's service and superintendence goes to each machine. The above are the items of cost of operation which vary the least with the varying conditions of the work and varying output, and may be roughly assumed to be constant whether the crane removes 300 cu. yds. or 600 cu. yds. per day.

The cantilever crane, like the cableway, is a conveying machine, and its output is greater or less up to a certain limit, according as the rapidity of excavating the rock and loading the skips approaches the capacity of the conveyors. One of the cranes has taken out 892½ cu. yds. in 10 hours, and 4,845 cu. yds. in a week. These, of course, are exceptional records, but they serve to show to what a great extent the capacity of the machine depends upon the rapidity of work in the pit. The hardness of the rock, character of the weather, efficiency of labor and superintendence and a dozen other variables determine the rapidity of work in the pit. The value of the figures of output given above lies in the fact that they involve all these variables, or, in other words, are records of actual outputs of rock excavated, extending over a considerable period of time and covering a number of machines.

Channeling Machine Work.—In the article describing the work on Section 8 there were given a number of records of the work of the Ingersoll-Sergeant channeling machines. All but one of the channelers used on Sections 11, 12 and 13 were supplied by the Sullivan Machinery Co., of Chicago, Ill., and we give herewith some records of these machines to supplement those of the Ingersoll-Sergeant channelers already recorded.

The problem of channeling the sides of the rock sections of the drainage channel offered difficulties never before met with by channeling machines. This class of machinery had heretofore been used exclusively on sound stone of the higher grades, such as marbles, oolitic limestones and sandstones. Any quarry that was not sound was soon abandoned, and all the unsound layers of rock were almost invariably removed by blasting before the channeler was set to work. On the canal entirely different conditions prevailed. The object in using the channeling machines was to secure as solid, unshaken and sound a wall as possible, and the more shaky the rock, the more important it was to keep the effect of the powder from the walls, and the channeler cut did this as nothing else could.

The limestone on the rock sections of this work varied very considerably from place to place, and often changed in a few hundred feet. In places it was hard, compact and flinty, with bands of chert, and in other places it was soft, shaken and filled with mud pockets. In a number of places the rock would be apparently sound on the surface, and a few feet down a pocket filled with clay would develop. In other places the whole rock wall would prove to be shaken up and full of seams, often running parallel with the channel cut, so that when the bit reached a depth of 6 or 8 ft. the whole side of the cut would cave in. Frequently cuts had to be abandoned for this reason before the depth of 12 ft. was reached, and it was not at all unusual on some sections to find the machine blocked up on timbers, working over a cut 2 or 3 ft. wide at the surface where the broken rock had fallen in and been removed by hand.

On the second and third cuts a new element of trouble came from the shaking of the rock by the explosions. When by chance the channel cut bottomed at or near a natural bed, or plane of stratification, the effects of the blast would hardly be felt on the rock below; but when the cut happened to come halfway through a bed, so that in removing the face the holes were drilled a foot or more below the bottom of the channel, the explosion would shatter the rock badly within the channeled line, so that when the next cut was put down the rock would be solid on the outside and shaken on the other, causing the "cuts" to run and become so crooked that the machine could not force the steel through them.

Again, on certain sections where there was a great deal of water, and when the contractor failed to take the necessary pains to draw it away from the walls, it would cover the surface where the channeling was being done, making it impossible for the runner to see what he was doing. This was especially bad in loose places on the second and third cuts. The rapidity with which the faces of the excavation advanced made it very troublesome to provide water for the channeling machines in cold weather, particularly on those sections where there was not earth enough to protect the water pipes from frost.

The following figures will give an idea of the variation in results owing to different conditions. The two machines selected were Sullivan No. 101 on Section 12 and No. 111 on Section 13. The cutting is taken from daily reports. That done in June, 1893, was on the top lift under favorable weather conditions, the short hours being accounted for by time lost in a labor disturbance.

The January, 1894, reports were taken under the most unfavorable conditions, third lift cutting, cold weather with the usual accessories of frozen water pipes, ice and snow; and in the case of machine No. 111 there are included five night shifts, which in winter means additional trouble. The time figured is that for which the men were paid, which includes all time lost for repairs and delays.

	Channeler 101. June, 1893.	Channeler 101. Jan., 1894.	Channeler 111. June, 1893.	Channeler 111. Jan., 1894.
No. hours worked	205	222	209	200
Sq. ft. channeled	2,783	1,401	3,076	1,683
Av. sq. ft. per hour	18.4	6.31	14.24	5.60
Max. sq. ft. per day	300[1]	126[3]	357[2]	96[3]
Min. sq. ft. per day	90[1]	18[3]	63[2]	12[3]

[1] 10-hour day; [2] 11-hour day; [3] 9-hour day.

These figures bring out very forcibly the point mentioned in the description of the channeling work on Section 8—viz., the effect of the nature of the rock, the weather, the lift on which work was done, etc.

The labor expenses of running the channelers on Sections 12 and 13 were about as follows:

Wages of runner per day	$2.75
Wages of foreman per day	1.75
Wages of helper per day	1.50
Blacksmiths and teams to haul drills	.68
Superintendence, including foreman and machinist	1.33
Cost of coal delivered to machine	2.50
Total	$10.51

The above figures as to blacksmiths and superintendence vary according as the contractor has more or less work for his regular force to do. They are based on employing men for the channelers alone. No figures of cost of repairs, steel, etc., are given. These machines were operated by the manufacturers, who received a stipulated price per square foot for the work done. On most of the sections the contractors purchased the machines outright and did the work themselves. Altogether 86 channeling machines have been used on the canal, 33 of which were supplied by the Ingersoll-Sergeant Drill Co., and 53 by the Sullivan Machinery Co.

UNIFORMITY OF METHODS IN TESTING WATER METERS.*

By John Thomson, M. Am. Soc. C. E.

The increasing use of water meters, and the rapidly-growing sentiment in favor of their application are leading to the more general testing of meters by water-works officials as also to more exacting requirements respecting their performance, and especially is this the case regarding the low-rate registration of the smaller sizes of meters used in domestic service. This observation at once leads to the query, Is it not time that more uniform methods of testing be adopted by the purchasers of meters, especially in the smaller calibers for domestic use?

It is believed that the question answers itself affirmatively, but among the reasons leading to this conclusion, it may not be amiss to mention that, as between the purchaser and the manufacturer, the advantage would be mutual, the single illustration sufficing that the conditions are here almost identical with that of uniform standards in pipe threads and flanges.

The corollary, then, is query number two: In what particulars of meter-testing should uniformity of methods be atempted? Here, undoubtedly, there is room for many opinions, and it is hoped that the discussion evolved may lead to a codification of present rules and practices. The writer selects the following features, which, to him, appear as most deserving of consideration and adoption, namely: (1) Should not the rating of meters, especially in low-flow tests, be by timing the deliveries of definite quantities, rather than by designating the diameter of jets? (2) What shall be be the limit of the minimum rate? (3) What shall be

*Slightly condensed from a paper read before the Burlington meeting of the New England Water-Works Association. The full paper will be published in the Journal of the Association.

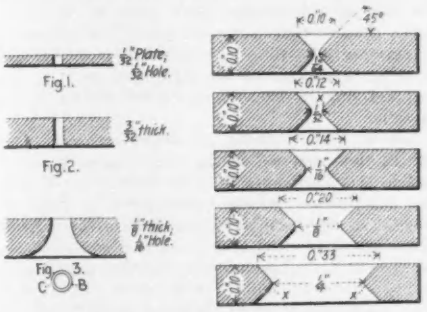
the limit of the maximum rate? (4) Should tests be referred to the meter on the tank? (5) Should the error be indicated in pounds or percentage.

Low Flows Should be Designated by Time Rating.

The writer is strongly of the opinion that the time rate should be adopted, as being correct in theory, and thoroughly demonstrated by long practice, especially so in Europe. The amount of uncertainty regarding this subject can probably be best attested by the venders of water meters, to whom the most widespread experiences converge.

Now, let it be said that in testing a meter at low flows the only point desired to be known is what quantity is passing in a minute or an hour. The sensibility of the meter is alone established by this. If one meter, to operate accurately, requires a draft of 2 cu. ft. uniformly drawn in one hour, and another meter operates with equal accuracy upon a draft of 1 cu. ft. in the same time, then the latter has twice the sensibility of the former. The only function, then, of a throttling diaphragm is to determine the rate of flow, and the only method of ascertaining this is to carefully rate the perforation by measuring its discharge under a definite pressure for a definite period of time. If time-honored truths will bear repeating, then so will hydraulic principles, which alone is the excuse for here presenting a few illustrations, with the view of impressing upon the memory the importance of following the procedure just recommended.

In Fig. 1 is represented, to large scale, a diaphragm, the original of which is 1-32 in. thick, the perforation being precisely 1-32 in. diameter, with the edges knife-sharp. The delivery of this orifice under a pressure of 50 lbs. per sq. in. is approximately 1 cu. ft. per hour. In Fig. 2 a diaphragm is represented to the same scale as Fig. 1, the original of which is 3-32 in. thick, having precisely the same diameter of orifice and the same knife-sharp edge on the upper side, but with the lower edge very slightly rounded by lightly scraping the edge with a sharp knife. The delivery of this diaphragm, under the same pressure as the former, with the upper sharp edge of the flow, is nearly



1, 2, 3. Diagrams Illustrating Results with Different Forms of Orifices in Meter Testing Diaphragms.

Fig. 4. Proposed Standard Meter Testing Diaphragms.

1.12 cu. ft. an hour. Hence the difference in thickness alone gives the thin diaphragm, at the pressure named, 12% less delivering capacity than the thicker one. Again, with this diaphragm reversed, the slightly rounded edge to the flow, the delivery is nearly 1.5 cu. ft. per hour, or 33% greater delivering capacity than from the sharp edge. These are to show how apparently trivial differences may greatly affect the comparison of results. Again, referring to Fig. 3, a diaphragm is represented in the original, of which the perforation is precisely 1-16 in. diameter, the thickness ⅛ in., one edge knife-sharp, and the other very nicely rounded to a curve of about ⅛ in. radius. This diaphragm, under a pressure of 50 lbs., each side being separately presented towards the pressure, gave the following results: With the upper sharp edge to the inlet, the delivery was about 5.3 cu. ft. an hour; reversed, with the lower rounded edge to the flow, the delivery was about 7.10 cu. ft. an hour, or nearly 34% greater than the first. The well-known reason for this difference in delivering capacity is indicated in the circles C, B, the inner circle, C, denoting the area of the contracted jet, from the sharp edge, while the outer circle, B, denotes the stream from the rounded side equal to that of the area of the orifice.

The practical application of this to the present subject is as follows: Suppose two meters equally accurate at 7 ft. an hour, and equally inaccurate at 5 ft. an hour. Then, furthermore, suppose that two water-works are supplied with these meters, requiring them accurate, according to their specification, on a jet 1-6 in. diameter at 50 lbs. pressure, and that it so happens that one of these works is provided with a diaphragm, sharp, as the upper side of Fig. 3, and the other works with a rounded perforation, as the lower side of said figure. Obviously, the works using the sharp-edged diaphragm will find the meter defective, whilst the other will accept its twin as correct. Evidently, had the meters been ordered to be correct at a minimum rate of 5 cu. ft. an hour, and had then been tested respectively under conditions to obtain this rate of flow, each purchaser would have been equally suited and the cup of human happiness would have been nearer to the full.

As a means leading to reach the result here aimed at, it is suggested that a standard form of perforation be adopted in the diaphragms used in testing water meters, and it is believed that the forms shown in Fig. 4, when taken with the simple method of their construction, would come well within the practical requirements of such service. In the several parts of this figure, which are drawn to a considerably enlarged scale, five diaphragms are shown, the diameters, at the throat sections of the perforations, being those already most generally employed, namely, 1-64, 1-32, 1-16, ⅛ and ¼ in., respectively.

To most conveniently accomplish the end here sought, it is essential that the diaphragms of a series shall be of uniform thickness, and No. 10 American gage, or approximately 0.1 in., has been selected, the metal to be of hard rolled brass. The production of any one of the perforations is as follows: First pierce with a drill one size smaller than the desired gage; second, with an accurately ground counter-bore, of 45° angle, counter-sink each side of the metal disk until the large diameter on the face, as noted in the drawing, shall be reached; third, the throat is then to be brought to exact diameter by reamer and round broach; and, finally, the sharp edge portions at the intersections of the throat with the cones, as at X, are to be lightly polished out, by using a pointed stick with pumice-stone. The object of sinking the counter-bore, to produce a definite diameter at the face, is to establish the depth of the cone, and these face dimensions are such as to produce a uniform thickness and contour at the throat in all of the sizes. The advantages of making both sides alike, and of counter-boring, are that either side may be presented towards the inlet, and that the throat is protected from injury.

If both the purchasers and the manufacturers of water meters would conclude to accept even this mild departure from existing practice, there would be a distinct gain to the good. And to those who may care to take up this practice, of referring comparative tests to a time basis, the accompanying time-rate testing table (Table I.) is presented approximately indicating the hourly deliveries which may be expected, in terms of cubic feet, when the diaphragms herein described are employed, and when the dynamic, or "running" pressure named is maintained at the diaphragm.

TABLE I.—Water Meter Bench-Testing Table, Giving Approximate Rates of Delivery in Cubic Feet per Hour of Nearest Even Quantity, Through Perforations Formed as Shown in Fig. 4.

Pressure, lbs. per sq. in.	Diameter, inches. 1-64th.	1-32d.	1-16th.	⅛th.	¼th.
	Cubic feet per hour.				
20	....	0.75	4.00	14	50
30	....	....	....	16	58
40	....	1.00	5.25	18	67
50	0.50	....	....	20	76
60	....	1.25	6.50	23	84
70	....	....	....	25	93
80	....	....	7.50	27	101
90	....	....	....	29	110
100	0.75	1.50	8.50	31	119

Note.—It was originally contemplated to prepare this table to show approximately exact deliveries for pressure increments of 5 lbs.; but after having prepared such a tabulation, it appeared to the writer that a wider range in pressures with quantities averaged to even amounts would adequately meet the requirements of regular service. Moreover, it is thought that the table, because of the increased simplicity and brevity, will be more likely to be utilized by practical men.

In carrying out these determinations of jet deliveries through the definite forms of perforation illustrated in Fig. 4, the water was weighed. A pair of Ashcroft test gages were used, these being specially compared and furnished under order to be graduated from a mercury column. The pressures were obtained by a Worthington pump and a Fisher regulator, both of which were specially overhauled and refitted for the purpose of obtaining this data. The pressure, as indicated by the gage, was maintained with satisfactory steadiness.

In Fig. 5 two sectional details are shown of a graduated valve for testing water meters by time-rating, as used by the writer's company, which so far has proven quite satisfactory in practice. This device consists of a simple plug-valve adapted to receive the flow at the side and discharge from a tube inserted in the end of the plug; about half the circumference of the side of the plug being recessed to the form of a V, gradually diminishing both in depth and width from the main inlet until vanishing in the surface, as denoted by the letter R. Applied to the upper extension of the plug is a dial plate, P, and inserted into the face of the casing is a sight pin, S. Obviously, by simply turning the plug so that different portions of the circular V-groove are presented to the inlet, the area of discharge may be very uniformly increased or decreased between the entire range of the scale. Then, by timing the delivery, any desired series or combination of tests may be made. In our practice the letter F is stamped on the graduated dial to indicate full flow; H for half; L for low, and S for sensibility. These, under 60 lbs. pressure, give approximate rates of 90, 40, 15 and 1.5 cu. ft. an hour. Where many meters are to be tested at different rates, this device effects a considerable saving in time over that required in the changing of diaphragms.

The Limit of the Minimum Rate.

As to the second query, What minimum rate should be insisted upon in water meters to be used in domestic service, the writer holds the opinion that this should be adapted to the conditions of the service. But the following general recommendation is ventured: When the water is reasonably pure and free from grit it is believed to be well within the power of manufacturers to regularly supply the smaller sizes of positive rotary and piston meters to indicate within 3% of accuracy at the rate of 1 cu. ft. uniformly drawn in one hour. And a meter which will do this may generally be depended upon to indicate, though not necessarily with much accuracy, down to from ¾ to ½ cu. ft. an hour. But the insistence upon such a degree of sensibility, except only where the water is free from grit, may invariably be taken as indicative of anything except good engineering sense. In this connection, however, it is not to be overlooked that the employment of meters and the reduction of waste tends to the betterment of a water supply.

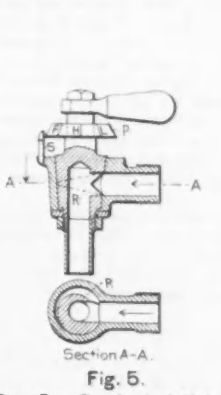


Fig. 5.

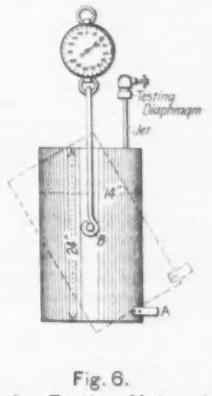


Fig. 6.

Fig. 5. Graduated Valve for Testing Meters by Time Rating.

Fig. 6. A Simple and Accurate Meter Testing Plant.

Galvanized iron can suspended on spring scale. Maximum testing capacity, 2 cu. ft., or 15 gallons. To empty, swing by handle, A, on trunnions, B.

As to the Maximum Rate.

And now, as to the third query of the opening, What should be the limit in testing a meter to maximum operation? The answer to this, as taken from general practice, is easy—namely, all that can be blown through. The writer has known of many cases where the only tests for accuracy in meters of the ⅝-in. size were at the rate of from 3 to 4 cu. ft. a minute, that is, from 300 to 400% in excess of usual practical requirements. In a test to demonstrate the durability, or the extreme power and capacity of a meter, such a trial may be eminently proper; but there appears to be but little warrant for such practice as a check for accuracy. However, opinions differ widely on this point, notwithstanding that there appears to be an entirely satisfactory basis for such tests, even though empirical—namely, the highest maximum delivery likely to be drawn through regular pipe service. It would seem that a velocity in the commercial sizes of ½, ¾ and 1 in. service pipe of, say, 15 lin. ft. a second is about as high as good practice would warrant. As a matter of fact, such a rate in practice is not common. Now, the velocity named would discharge nearly 1.8, 2.8 and 4.8 cu. ft., respectively; hence, a bench-test for accuracy at maximum rate probably need not exceed, say, 2 cu. ft. a minute for ½ or ⅝-in. meter; 3.5 for the ¾-in. meter, and 6 ft. for the 1-in.

In Low Rate Flows Should the Meter be Throttled at the Inlet or the Outlet?

The inquiry is occasionally made if, in testing a meter under low flows, it makes any difference in the result as to whether the meter be throttled at the inlet or the outlet thereof. Generally speaking, it is more favorable to the meter to throttle at the inlet, leaving the outlet fully open, as it is thus relieved of all strain except that of the back pressure of the outlet pipe. If meter devices were in theoretically perfect equilibrium, under pressure, there would be no difference, but there is no such mechanism. Consequently, if it were desired to obtain registration at the

(Continued on page 186.)

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published every Thursday at Tribune Building, New York.
Entered at the Post Office, New York, as Second Class Matter.

D. McN. STAUFFER, CHARLES WHITING BAKER.....EDITORS.
WM. KENT, E. E. R. TRATMAN, M. N. BAKER, CHAS. S. HILL, A. B. GILBERT.....ASSOCIATE EDITORS.
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ALFRED E KORNFELD, New York; F. A. PECKHAM, Chicago.....ADVERTISING REPRESENTATIVES

PUBLICATION OFFICE.....Tribune Building, New York.
CHICAGO OFFICE.....1636 The Monadnock.
LONDON AGENCIES: KEGAN PAUL, TRENCH, TRUBNER & Co. (Limited), Paternoster House, Charing Cross Road; SAMPSON LOW, MARSTON & Co. (Limited), St. Dunstan's House, Fetter Lane.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; 6 months, $2.50; 2 months, $1.00: single copies, 15 cents. To all other countries in the Postal Union, add $2.08 per annum (4 cents per number) to above prices for postage. No club rates allowed. Mailing addresses may be changed at will by sending both old and new address. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay. The date when the subscription expires is on the address label on each paper: the change of that to a subsequent date is the only receipt sent, unless by special request.

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The second annual meeting of the American Society of Municipal Improvements was held in Cincinnati last week, and a report of its proceedings is given in another column of this issue. This second meeting is of especial interest apart from the papers and discussions, as indicating what is to be the general field of usefulness which this new society will fill. The avowed object of this society is to promote information upon and to discuss the best methods to be employed in the management of all municipal departments and the construction of municipal works.

It is apparent from this that a large part of the subjects which the society proposes to consider come within the field of engineering. Paving, sewerage, street lighting, garbage disposal, water supply and distribution, all these are certainly engineering work, and a man must have some knowledge of engineering principles and practice in order to discuss them intelligently. The question may be asked, therefore, whether it is wise to start another society devoted in large measure to the special field of municipal engineering. Why should the city engineers not read their papers on paving, or sewerage or water supply before the American Society of Civil Engineers, or before some of the local engineering societies, instead of joining an independent society for the consideration of this especial field of engineering?

In answer to this query, however, we imagine that the city engineers can give some excellent reasons for their support of a society devoted to the subjects in which they are especially interested. Suppose a city engineer prepares a valuable paper on some subject in the field of municipal engineering, and reads it before the American Society of Civil Engineers. If he presents it before one of the semi-monthly meetings, he must make a long and expensive journey to New York, or else have it read in his absence by the Secretary. In either case, there are likely to be, out of the total number in attendance at the meeting, only a very few who have had sufficient experience in the special line of work described to intelligently discuss it. If he reads the paper at the annual convention, the lack of discussion is likely to be still more evident.

Now it is safe to say that the engineer who reads a paper before a society, hopes for and desires a full discussion of the ideas presented. The average city engineer is, to a considerable extent, isolated in his professional work. He may win the approbation of the public and of the other city officials; but a man, if he be really ambitious and desirous of attaining a high standard, desires nothing so much as to have his work judged by experts. The city engineer who carries out a difficult piece of work naturally desires to know how it compares with the best work of other city engineers.

If he stands little chance of securing friendly and helpful criticism if he reads a paper on his special work before the American Society of Civil Engineers, he stands less chance if he prepares a paper for the local engineers' society. The few among the members who can discuss the paper intelligently are apt to be themselves either ex-city engineers or possible future candidates for the office, and fear of "treading on somebody's toes" will result in the paper being passed with but a few words of discussion.

There are other phases of the question which may be referred to. It may safely be assumed that an engineer who prepares a professional paper desires some gain in professional reputation as a return for his work. Evidently the greatest gain of this sort will accrue when he reaches the largest number of readers, and especially when he reaches the class of readers to whom he looks for patronage and position. With these facts in mind, it can be easily seen why a city engineer may prefer to attend and read papers at a convention made up of other city engineers and the heads of departments of other cities rather than a convention of the American Society of Civil Engineers.

In what has preceded, however, we have had in mind the Society of Municipal Improvements as it may be, and as it is to be hoped it will become, rather than the society in its present state. Last year's meeting did little more than lay the foundation for a permanent organization. The Cincinnati meeting just held brought together a gathering gratifying in point of numbers, and to a fair degree in point of the position and standing of the men who composed it; but it left the question still somewhat undecided whether the element which desires the meetings to be devoted to work which shall give the society high standing, or the element which regards the meetings as merely an excuse for a holiday and general good time, shall control the society's affairs. In so far as the election of its officers is a criterion, however, we may believe that the former element is to be the influential one, and that the society is destined to become an organization which will do much to promote good work in the administration of municipal corporations.

THE ACCELERATION OF THE SPEED OF EXPRESS TRAINS.

Interest in the question of fast trains, which is always more or less in evidence in the popular and technical mind alike, but which has lain dormant since the excitement over the "Exposition Flyer," of 1893, has again been aroused by the recent splendid performances of long-distance express trains in England and in this country, and it seems appropriate at this time to briefly review the development of the fastest long-distance express services, and to discuss some of the questions to be considered in regard to the acceleration of such service.

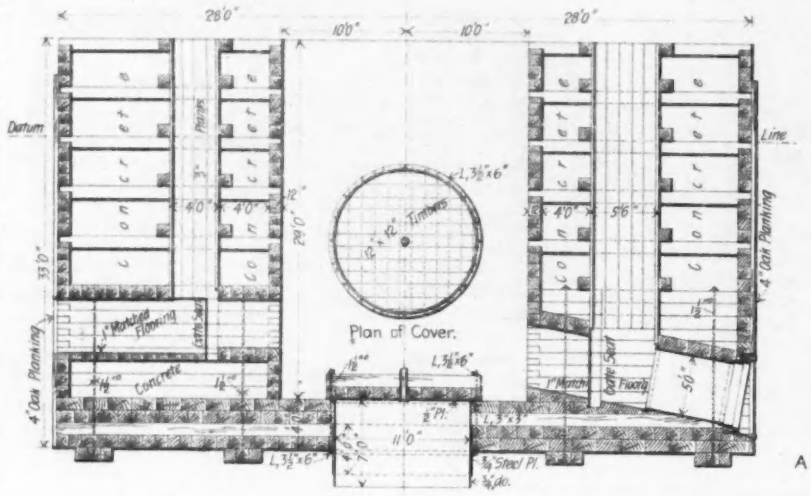
The combination of the highest speed for the greatest distance was reached in 1893 by the "Exposition Flyer," which, during the Columbian Exhibition, ran regularly between New York and Chicago, over a route 980 miles long at an average speed of 49 miles per hour for the entire trip, including stops. This train was established by the New York Central & Hudson River R. R. in conjunction with the Lake Shore & Michigan Southern R. R. The former road had also previously established a record for long-distance express trains by its famous Empire State express, between New York and Buffalo, which began running in 1891, and which now makes the run of 440 miles in 8 h. 40 min., the average speed from start to finish being 50.76 miles per hour, including stops. This is a regular train making its run in each direction six days a week, and its cars are nearly always well filled, the train being both popular and remunerative.

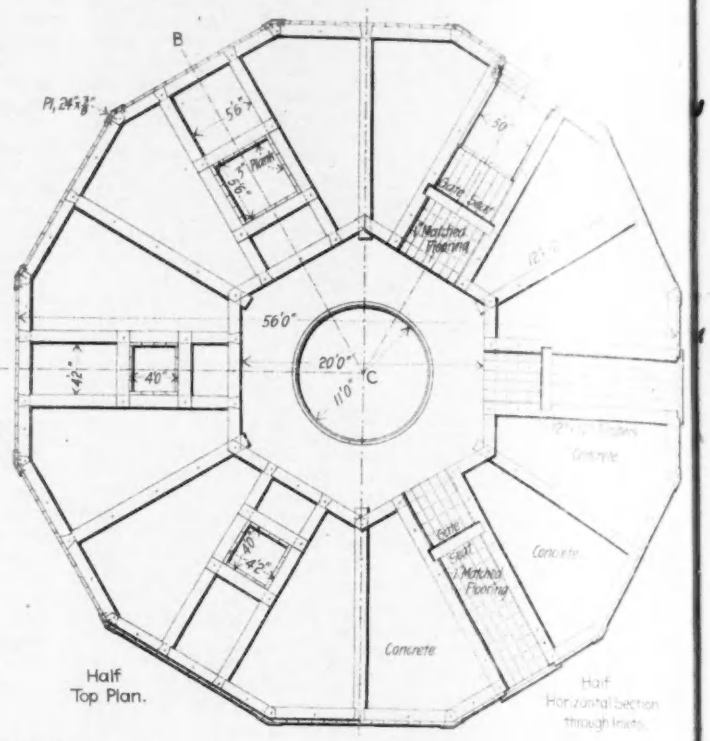
In July and August of this year the railways forming two rival routes between London and Aberdeen have been reducing their times considerably on the through run, and have increased the average speed for the entire trip from 45 miles per hour to 60 miles per hour over a run of 52[illegible] miles in one case, and from 45.8 to 63.3 miles per hour over a run of 540 miles in the other case. The trains for these record speeds were very light. The latter one, in fact, weighed only about 68 gross tons, and these speeds have not been adopted for the regular train schedule. These bursts of speed on English railways induced the New York Central R. R. to attempt a new record, and on Sept. 11, 1895, it ran a special express train from New York to Buffalo, which made the run in 412 minutes, or at an average speed of 63.57 miles per hour for 436½ miles. The make-up of this train was nearly identical with that of the regular Empire State express; the total weight was about 160 gross tons behind the tender. Thus, while the fastest English train had the greater length of run by 100 miles, the American train made a somewhat higher speed with more than twice as great a train-load, and had a very much greater passenger capacity.

This is, in brief, the present situation. The record runs made by the English trains appear likely to have little effect in accelerating the speed of the fastest trains on the regular schedule of the roads which made these records. In the United States, on the other hand, it is said that the success of the trial run on Sept. 11 may lead to an acceleration of speed and a reduction of the schedule time of the Empire State express, which will make it somewhat more convenient for passengers by starting later than its present time of 8:30 a. m., arriving in Buffalo at the same time as at present, and arriving in New York rather earlier than at present.

Let us now consider in somewhat more detail the English records on the rival routes from London to the North; and it is of interest to note that the competition which commenced in 1888 was started by the action of the Great Northern Ry. in adding third-class cars to its fastest trains, making the run from London to Edinburgh and Glasgow (392½ and 439¾ miles) in 9 hours and 10 h. 20 min., respectively, or at the rates of 43.9 and 42.57 miles per hour. The London & Northwestern Ry. already had third-class cars on its fastest trains between the same points, but the time was about 9 h. 45 min. or 10 hours to either place (400 and 401 miles, respectively), or at the rate of about 40 miles per hour, so that the third-class traffic would naturally have gone to the new route made available for it. It is not necessary here to go into the details of the now famous "Race to the North," which resulted in establishing the schedules given below. The Midland Ry. did not take part in the excitement, owing largely, it is said, to the more severe physical disadvantages of its route, and to the fact that its enormous coal and mineral traffic precluded any material acceleration of its express train service.

Since that time the completion of the new Tay Bridge and the great Forth Bridge have given the East Coast route a direct line north from Edinburgh to Aberdeen, and this summer the East Coast and West Coast routes inaugurated a "race to Aberdeen," which produced some very interesting results. The two routes are said to be pretty evenly matched. The East Coast route (Great Northern, Northeastern and North British railways), 523 miles, is 17 miles the shorter, and has easier grades, but it has a dead-end terminal at Newcastle, several miles of single track and numerous sharp curves on the North British Ry., and makes shorter runs between stops. The West Coast route (London & Northwestern and Caledonian railways), 540 miles, has some grades as steep as 1.33 per cent., but it is free from the other disadvantages of the East Coast route, and can make longer runs between stops by reason of the use of track tanks. The East Coast route unites with the other 40 miles south of Aberdeen,





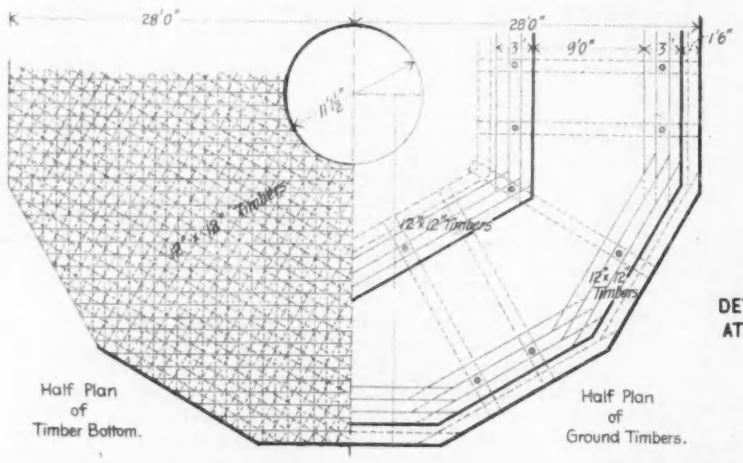
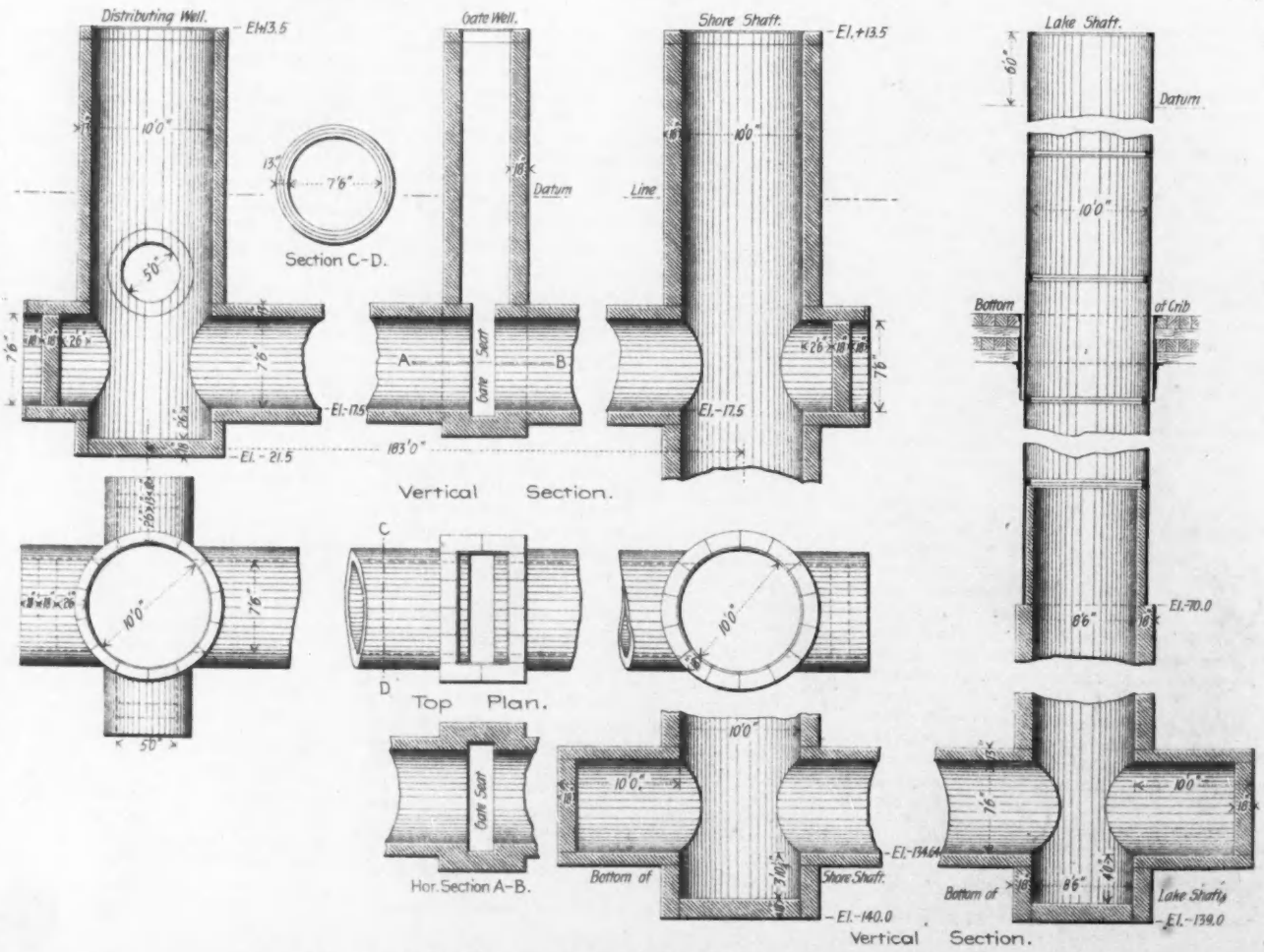


FIG. 6.
DETAILS OF CRIB
AT LAKE SHAFT.



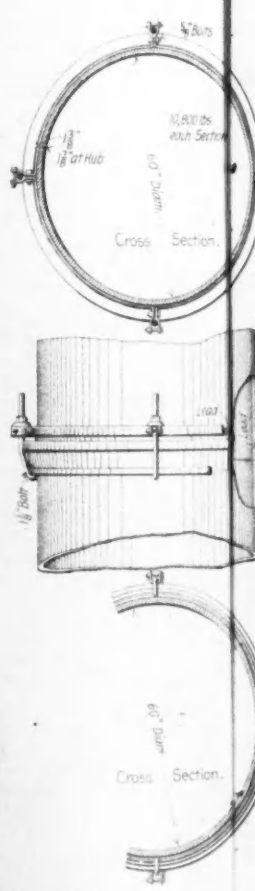


FIG. 8. SUBMARINE JO
FOR 60 IN. CAST IRO
INTAKE PIPE.

FIG. 10. DETAILS OF WELLS AND SHAFTS WITH TUNNEL CONNECTIONS.

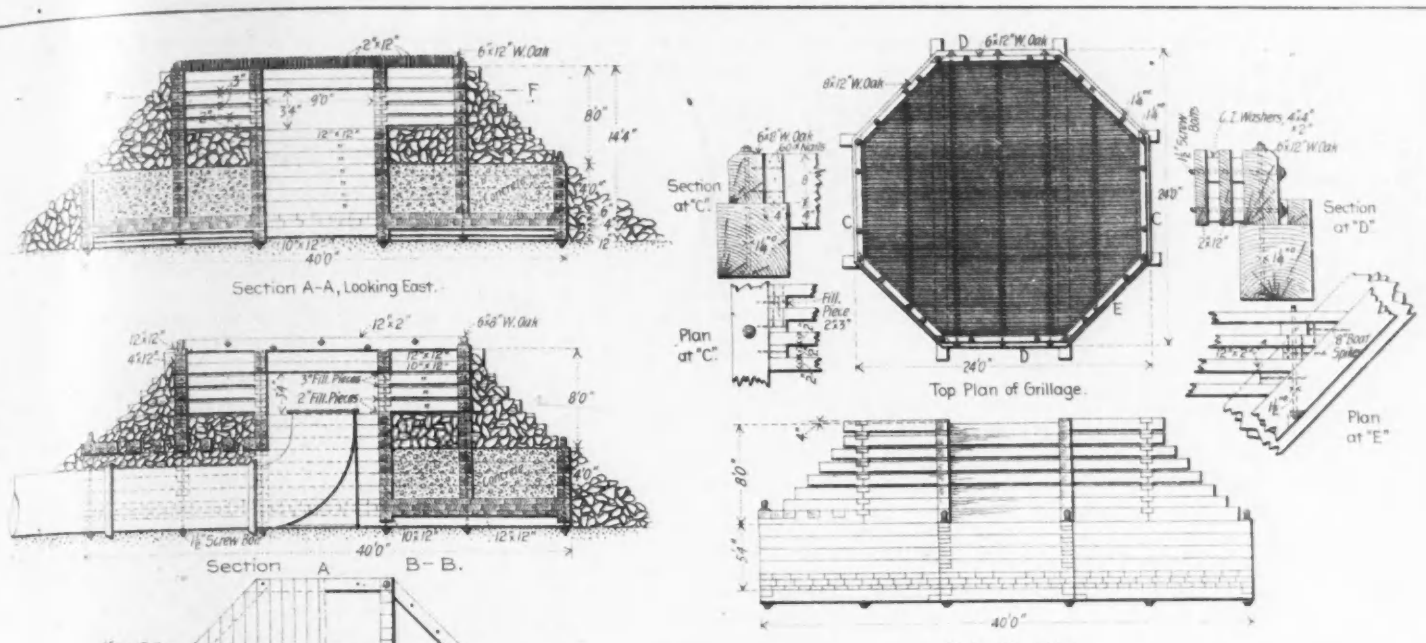
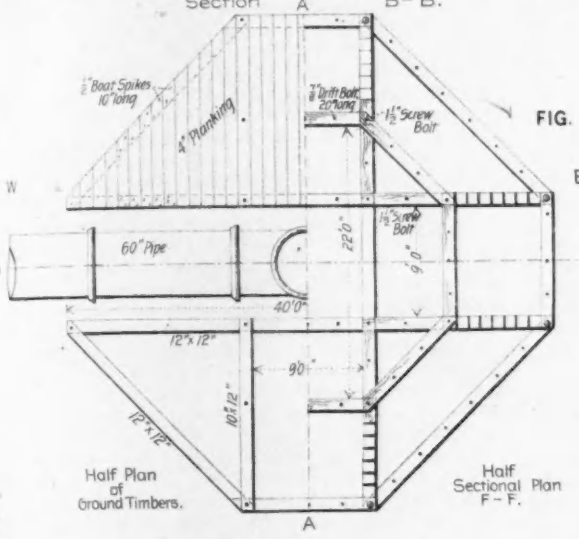


FIG. 7. DETAILS OF SUBMERGED INTAKE CRIBS.



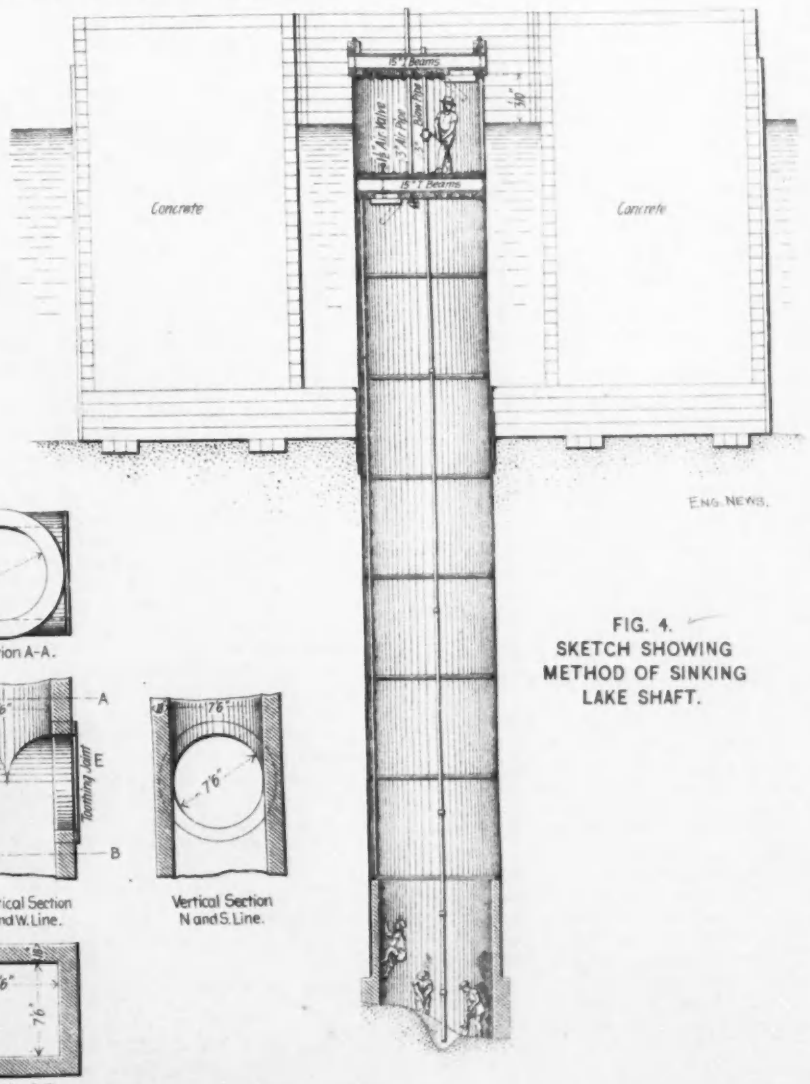
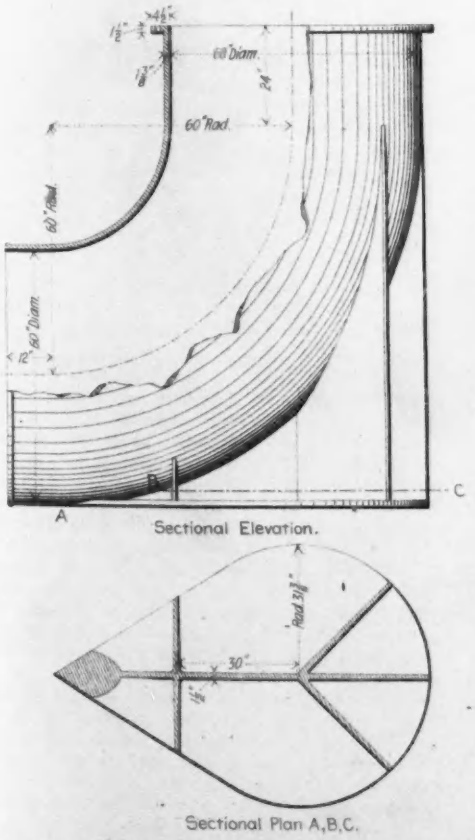


FIG. 4.
SKETCH SHOWING METHOD OF SINKING LAKE SHAFT.



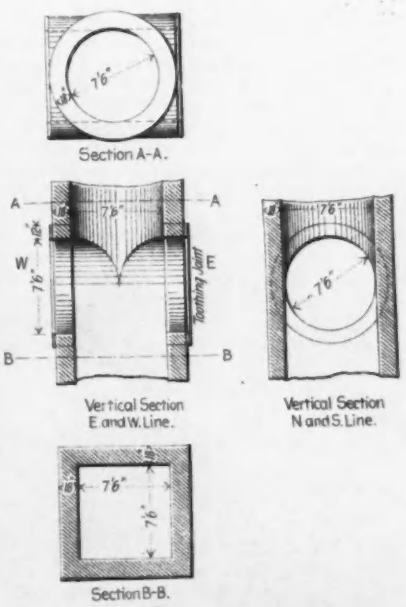


FIG. 5. DETAILS OF CONNECTIONS OF LAKE SHAFT AND TUNNEL MASONRY.

FIG. 9. CASTING FOR END OF CAST IRON INTAKE PIPE.

WATER SUPPLY INTAKE, MILWAUKEE, WIS.

GEO. H. BENZENBERG, M. AM. SOC. C. E.,
CITY ENGINEER.

CHAS. HEIST & SONS, LITH., 95 VESEY ST., N. Y.

English Accelerated Schedules of 1888.

	Miles.	Time. h. m.	Average speed. Stops deduct. M. p. h.	Average speed. Stops includ. M. p. h.
East Coast Route.				
To Edinburgh (G. N. Ry. and No. East. Ry.)	392½	7 45	54	50⅔
To Glasgow (G. N. Ry., N. E. Ry. and No. Brit. Ry.)	439¾	9 45	49¼	45
West Coast Route.				
To Edinburgh (L. & N. W. Ry. and Caledonian Ry.)	400¼	8 0	53⅓	50
To Glasgow (" " ")	401½	8 57	49	45
Midland Route.				
To Edinburgh (Mid. Ry. and No. Brit. Ry.)	413	9 44	46¼	40
To Glasgow (Mid. Ry. and Glas. & So. W. Ry.)	423	9 22	42 2-5	45

so that its trains have to run this distance over the rival Caledonian Ry., and the actual "race" was therefore to this junction.

Up to July last the regular schedule time by the East Coast route was 695 minutes for the 523 miles, or at the average rate of 45 miles per hour throughout. This was cut down during the "race" to 521 minutes, giving an average speed of about 60 miles per hour. The trains on this route weighed about 175 to 195 tons behind the tender, but the fastest run was made with a train of only six six-wheel cars, weighing 101 tons. The engines used on the southern part were of the single-driver type, with driving-wheels 8 ft. 1 in. and 7 ft. 7 ins. diameter, and cylinders 18½ × 28 and 19 × 24 ins.; while on the northern part eight-wheel engines were used, having driving wheels 7 ft. and 6 ft. 6 ins. diameter, and cylinders 19 × 26 ins. and 18 × 26 ins., respectively. On some of the runs two of these latter engines were run as double headers from Newcastle to Edinburgh, or Edinburgh to Aberdeen. The time by the West Coast route in July was 710 minutes for the 540 miles, or at the average rate of 45 miles per hour throughout, and this was cut down gradually to 512 minutes, giving an average speed of 63.29 miles throughout. This was done, however, with a train reduced from the ordinary weight of 110 to 207 tons to three eight-wheeled cars, representing only 68 tons behind the tender. The engines used on the southern part were of the six-wheel type, with four coupled wheels, including Webb three-cylinder compounds, with driving wheels 7 ft. 1 in. diameter and cylinders 14 × 24 and 30 × 24 ins., and simple engines with driving wheels 6 ft. 6 ins. diameter and cylinders 17 × 24 ins., the latter being sometimes assisted by a pilot engine with a single pair of driving wheels 7 ft. 6 ins. diameter, and cylinders 16 × 24 ins. On the northern part of the route eight-wheel engines were used, having driving wheels 6 ft. 6 ins. diameter and cylinders 18 × 26 ins., two of these engines double-heading north of Carlisle over the heavy grades. The lengths of run between stops are shown on the accompanying table, and it will be seen that engines were changed four times on the East Coast and three times on the West Coast route:

East Coast.	Miles.	West Coast.	Miles.
London	...	London	...
Grantham*	105¼	Crewe*	158
York*	82¾	Carlisle*	141¼
Newcastle*	80½	Stirling	117¾
Edinburgh*	24½	Perth*	32¼
Dundee	59¼	Forfar**	33¼
Arbroath**	59¼	Aberdeen	57¼
Aberdeen	54¼		
Total run	523½	Total run	539¼

* Engines changed at these points.
** These stops omitted on the fastest runs.

According to the reports in the English technical papers much unnecessary time was often lost at stations, the stops consuming from five to ten minutes, which is, of course, a serious matter in fast train service. In the first place, special care should be taken to have the tracks clear, so that the train need not be checked or delayed in approaching or leaving stations; and if there is much baggage to be handled, it should be conveniently arranged beforehand, ready to be put directly into the baggage car. The trains rode steadily and comfortably, and the superior riding of the cars mounted on bogies or trucks is commented upon by one of the technical writers who made the journey. These record runs, however, do not establish a regular service at such speeds, the "race" having been closed by the great run on the West Coast route of 540 miles in 512 minutes. The present schedule is 630 minutes for the 540 miles on this route, or an average of 51.29 miles per hour, while on the East Coast route it is 625 minutes for the 523 miles, or an average of 50.21 miles per hour. Comparing the above with American records, it may be stated that the special train of the New York Central R. R. on Sept. 11, particulars of which are given below, made a record of 436½ miles in 412 minutes, or at the average rate of 63.57 miles per hour throughout, while the regular Empire State express on the same line makes its 440 miles in 520 minutes, giving an average speed of 50.76 miles per hour. Of course, both the English and American trains attained very much higher actual maximum running speeds between stops, probably 70 to 80 miles per hour, but these are outside the question of maximum speed from start to finish of the entire trip.

It will be interesting now to trace in a similar way the development of long-distance express service in this country. In September, 1891, the New York Central R. R. ran a special train from New York to East Buffalo, 436½ miles, in 439 minutes, or at the average rate of 59.64 miles per hour, or 426 miles running time, which gives an average of 61.144 miles per hour, with stops deducted. This train was made up of three cars aggregating 259,600 lbs. (or 116 gross tons), and was hauled by eight-wheel engines with driving wheels 5 ft. 9 ins and 6 ft. 6 ins. diameter, and cylinders 19 × 24 ins., the weight of engine and tender being about 90 gross tons. Engines were changed twice. This train was run in view of a proposed acceleration of the express train schedule between New York and Buffalo, the fastest schedule then being 638 minutes, giving an average speed of 41.38 miles per hour. As a result the now famous Empire State express was shortly afterwards put on, with a schedule speed of 50.75 miles per hour throughout, or 53 miles per hour with four stops deducted. This train at first had a weight of 130 tons behind the engine, but the train became so popular that another car had to be added, increasing the load to about 170 tons. Later on some large cars were built specially for this service, and the present weight of the train is about 170 tons. The engines are of the eight-wheel type, three engines being used on the run, and these have driving wheels 6 ft. 6 ins. and 7 ft. 2 ins. diameter, and cylinders 19 × 24 ins. The cars and engines for this train were described and illustrated in our issues of May 18 and Dec. 14, 1893. The following table gives the particulars of this train as now in service, and it is undoubtedly the most celebrated express train in the world, having been in regular service for about four years, maintaining its long-distance schedule speed uniformly, and having also the records of the fastest actual time ever made on a railway—namely, one mile in 32 and 35 seconds, or at the rate of 102 and 112 miles per hour.

Empire State Express.

	Time.	Miles.	Mins.	Miles per hr.
Leave New York	8:30 a. m.	...	...	.....
Arrive Albany	11:15 "	143	165	52.31
Leave Albany	11:20 "	...	...	.....
(Intermediate stop at Utica at 1:10 p. m.)				
Arrive Syracuse	2:15 p. m.	148	175	50.76
Leave Syracuse	2:20 "	...	...	.....
Arrive Rochester	3:43 "	80	83	57.7
Leave Rochester	3:47 "	...	...	.....
Arrive Buffalo	5:10 "	69	83	50.0
Total (deducting stops)		440	506	52.17
Total from start to finish, including four stops, slow run from East Buffalo to Buffalo, and all detentions.		440	520	50.76

Train.	
1 buffet, smoking and baggage car	93,500 lbs.
2 day cars	182,100 "
1 parlor car	101,300 "
Total behind tender	376,900 lbs.
Locomotive and tender	200,000 "
Total weight of train	576,900 lbs.

We now come to the most remarkable long-distance express train ever put in service, having a run of more than twice the length of that of the Empire State express, and maintaining throughout a speed but little lower than that of the latter. The prospects of heavy traffic between New York and Chicago in 1893, in connection with the Columbian Exhibition, called attention to the desirability of accelerating the express service between these cities, and in May of that year the "Exposition Flyer" was inaugurated by the New York Central and Lake Shore & Michigan Southern railways, making the run of 980 miles over this route in 20 hours, or at the average speed of 49 miles per hour for this immense distance. This train was made up of five through sleeping cars, representing a weight of 400,000 lbs. (180 gross tons) behind the tender, and this was increased to 480,000 lbs. by the addition of a dining car over certain portions of the line. The engines were of the eight-wheel type, those on the New York Central R. R. having driving wheels 7 ft. 2 ins. diameter and cylinders 19 × 24 ins., and weighing (with tender) about 91 tons; while those on the Lake Shore & Michigan Southern Ry. had driving wheels 6 ft. diameter, cylinders 17 × 24 ins., and weighed (with tender) about 78 gross tons. An interesting description of this train, from the pen of the late A. M. Wellington, will be found in our issue of July 6, 1893. This train ran daily, in each direction, during the time of the exhibition, and proved to be as steady and comfortable at the high speeds required as the ordinary express trains, while in popularity and financial profit it proved almost as great a success as the Empire State express. The service ceased with the close of the exhibition, and has not since been renewed, for financial and commercial reasons. The present fastest schedules by the four principal routes between New York and Chicago are 24 hours by the New York Central and Lake Shore & Michigan railways (980 miles at 40.86 miles per hour); 24 hours by the Pennsylvania R. R. (913 miles at 38 miles per hour); 25 hours by the New York Central and Michigan Central railways (976 miles at 39 miles per hour), and 29 hours by the New York, Lake Erie & Western R. R. (986 miles at 34 miles per hour).

Matters have rested thus since 1893, the Empire State express running regularly its 440 miles at 50.76 miles per hour, and the fastest Chicago expresses running regularly their 980 and 976 miles at 42.6 and 42.43 miles per hour. The new "race to the North," started by English trains, however, aroused the New York Central R. R., and it was decided to see what could be done in the way of accelerating the speed between New York and Buffalo. Accordingly on Sept. 11 a special train was started from New York at 5:40 a. m., and reached East Buffalo at 12:32 p. m., having made the run of 436½ miles in 412 minutes, or at the average speed throughout of 63.57 miles per hour. This is slightly better than the speed maintained by an English train for a run of 540 miles, but while the English train weighed but about 68 tons behind the tender, the American train weighed about 160 tons behind the tender. The train was made up of four vestibuled cars, and three engines were used, all of the eight-wheel type, as used for the Empire State express. From New York to Albany engine No. 870 was run, weighing (with tender) 201,000 lbs.; from Albany to Syracuse, No. 999, weighing 204,000 lbs.; from Syracuse to East Buffalo, No. 903, weighing 202,000 lbs. The train was 337 ft. long, weighed 565,000 lbs. in all, and had accommodation for 218 passengers. The road has the disadvantage of numerous grade crossings to contend with, and there are grades of 1.75% and 85% to be surmounted, an extra engine being used on the former. The track is of excellent construction, laid with 80-lb. and 100-lb. rails, and the block system is in force for the entire distance. The clearing of the track for this train did no interfere with the regular traffic, a time being chosen which would least discommode the regular train service, but all freight trains running in the same direction (the line having four tracks) had orders to stop at the time the express was due, to avoid danger from falling car doors, etc. The only other extra precautions taken were at street and railway

grade crossings. We are indebted to Mr. Edgar Van Etten, General Superintendent of the New York Central & Hudson River R. R., for the official figures of the run, and he states that the fastest time made was at the rate of about 81 miles per hour for a mile or so. The details of the run of this train are given below.

Special Run; Sept. 11, 1895.

	Time.	Miles.	Mins.	Miles per hr.
Leave New York	5:40:30 a.m.	...	...	...
Arrive Albany	7:54:55 "	143	134	64.03
Leave Albany	7:56:45 "	...	...	...
Arrive Syracuse	10:17:10 "	148	140½	63.00
Leave Syracuse	10:19:35 "	...	...	...
Arrive East Buffalo..	12:32:26 p.m.	145½	133	65.64
Total (stops deducted).....		436½	407½	64.31
Total, start to finish*.....		436½	412	63.57

* Including two stops and about 28 times slackening speed.

Train.

1 smoking and baggage car.....	83,470 lbs.
2 day cars (82,140 and 83,700 lbs.).....	165,840 "
1 private car	109,000 "
Total behind tender*.....	361,000 lbs.
Locomotive and tender	202.000 "
Total weight of train.....	563,000 lbs.

* Including passengers and supplies.

From what has been said, it will be seen that honors are about even between the two countries for special trains running long distances at high speed, and that both the English lines have now established new schedules which approximate with that of the Empire State express, one of the former being a little lower and the other a little higher than the latter. In weight of train and in carrying capacity the American train is far ahead of the English trains, for while the latter could not, according to reports, carry enough passengers to make the train a paying investment, the latter had seating and feeding accommodation for 218 passengers. For convenience of reference we tabulate the figures already given as follows:

Long-Distance Express Trains.

	Distance, miles.	Time, mins.	Speed, start to finish. M. p. h.	Weight of cars, tons.
London to Aberdeen:				
West Coast route, fastest.	540	512	63.29	68
" " " present.	540	630	51.29	100 to 200
East coast route, fastest.	523	521	60.00	100
" " " present.	523	625	50.21	100 to 200
New York to Chicago:				
"Exposition Flyer," 1893.	980	1,200	49.00	180
Penn. R. R., present....	913	1,440	38.00	150 to 450
N. Y. C. R. R. and L. S & M. S. Ry., present.....	980	1,440	40.86	"
N. Y. C. R. R. and M. C. R. R., present.....	976	1,500	39.00	"
N. Y., Lake Erie & W. R. R.....	986	1,740	34.00	"
New York to Buffalo, N. Y. C. R. R.				
Empire St. ex., regular..	440	520	50.76	170
Special, Sept. 11, 1895...	436½	412	63.57	160

During the last ten years or more a great deal has been said and written in regard to the attainment of an ideal speed of 100 miles per hour by railway trains, and in general such a speed has been looked upon as almost impracticable. In fact, it was very commonly regarded as impossible until it had been attained, and since then it has been considered to be impracticable on account of commercial and operating difficulties. While the fact remains that records of one-mile bursts of speed at the rate of 102 and 112 miles per hour (35 and 32 seconds per mile) have been attained by the regular Empire State express on the New York Central R. R. (Eng. News, May 18, 1893), there seem to be no present indications of such speeds being frequently attained, or being maintained for any appreciable length of time, and short bursts of such high speeds are merely of incidental scientific interest, and have little bearing upon the questions involved in the operation of express train service. What is of more practical interest is the maintenance of ordinary express speeds on long runs, thus accelerating the average speed and reducing the time of the trip, and in this respect the indications point to considerable advances. The question of speed which is of most interest and importance to the operating department of railway service, is what one of the speakers at the recent International Railway Congress termed "commercial speed"; that is to say, the average speed from the point of departure to point of destination. This is true of both passenger and freight traffic, for neither passengers nor shippers calculate upon the actual train speed, but upon the time consumed by the trip. Thus in some cases there are a slow and a fast train, so called, which yet make about the same time between certain points, the former leaving perhaps an hour before the latter, and arriving a quarter of an hour earlier at their common destination. The slow train, having many stops to make, may have to attain between stations a speed as high as, or even higher than, that of the fast train, which makes no stops, and thus maintains a steady high speed. It need hardly be pointed out that practically all passengers between the two terminal points of the common trip will take the latter train, regardless of the higher speed records which may, perhaps, be made by the former.

In any proposition for a reduction of time between two important points, it must be borne in mind that if a train is to be popular and financially successful, it must meet the demands and the convenience of the traveling public. Thus, in the case of the English trains, the present schedule, by which the trains leave London by 8 p. m. and reach Aberdeen at about 6:30 a. m., is really more convenient for passengers than the fastest schedules of the "race," by which the trains left at the same time, but arrived at Aberdeen between 4 and 5 a. m. If the fast time had been adopted for regular service, the convenience of passengers would probably be better served by making the time of departure later, so as to allow an unbroken evening in London, as it is of little use to get passengers by a night train to their destination before 6:30 or 7 a. m. Similarly in regard to the Empire State express, a reduction of half an hour in the time would be made most convenient to passengers by starting the train from New York at 9 a. m., instead of 8:30, arriving at Buffalo at 5:10, as at present, but starting from Buffalo at 1 p. m., as at present, arriving in New York at 9:45 p. m., instead of 10:15 p. m. In the same way, taking the times of the fastest trains between New York and Chicago, as given below, it will be seen that the 24-hour Pennsylvania R. R. westbound train is rather more convenient than the Lake Shore R. R. 25-hour train, by giving passengers half an hour more in the morning before leaving, and still put them into Chicago a little earlier, but without arousing them at an uncomfortably early hour. On the other hand, the 26-hour eastbound train on the Michigan Central R. R. appears to be awkwardly timed, as a journey by it practically kills two days, while the 29-hour train on the Erie R. R. leaves the entire morning of the first day clear for business or pleasure, and is practically the more convenient train of the two.

New York to Chicago.	Leave N. Y.	Arrive C.	Hours.
Pennsylvania	10:00 a. m.	9:00 a. m.	24
Lake Shore.....	9:30 "	9:30 "	25
Mich. Cent.....	4:30 p. m.	4:30 p. m.	25
Erie	3:00 "	7:00 "	29
Chicago to New York.	**Leave C.**	**Arrive N. Y.**	**Hours.**
Pennsylvania	5:30 p. m.	6:30 p. m.	24
Lake Shore	5:30 "	6:30 "	24
Mich. Cent.....	10:30 a. m.	1:45 p. m.	26¼
Erie	3:00 p. m.	9:00 "	29

This question of the relation of high speeds to length of run was discussed at some length in our issue of Nov. 7, 1891, and the same conditions hold true in regard to freight traffic in many cases. Thus, in a discussion on this subject of the acceleration of freight service at the International Railway Congress, a Belgian engineer stated that on his road there was a considerable traffic in coal, but the trains are run at night, and as long as they reach the docks at Antwerp by 7 a. m., as at present, there is no advantage in increasing the speed. On the other hand, it was shown that the Paris, Lyons & Mediterranean Ry. has so accelerated its freight service between Paris and Cette as to reduce the time nearly 50 per cent.

In arranging for a shorter schedule for express service a variety of questions enter into consideration and complicate matters considerably. For instance, it must be carefully studied as to where the speed can be increased to best advantage, taking the grades and curves into account, as discussed by Mr. de Busschere in his book on "Virtual Length Relative to Speed on Railways," reviewed in our issue of Nov. 15, 1894, and also taking into account the time which will best suit the convenience of the traveling public and the interference with other trains, which will perhaps make it necessary to introduce changes in the schedules of the latter. If the higher speed is to be regularly maintained many improvements in eliminating switches, realining awkward curves, etc., may be carried out with advantage. Then the power required and resistances to be overcome must be considered (Eng. News, June 9, 1892, and Sept. 12, 1895), and due regard must be given to questions of track and track equipment, bridges, and, last, but by no means least, the signal equipment. As to the question of safety, it may reasonably be said that there is no more danger at 64 miles per hour than at 50 miles per hour, and, in fact, the faster train being of exceptional reputation and interest, would probably be looked out for with even more care than the slower expresses. It is to be assumed, however, that such speeds will not be regularly attained on any roads but those having the most excellent construction and being operated by the block system, or with any but the best constructed and equipped trains. All these various and inter-related questions have to be taken into account to arrive at a satisfactory solution of the problem of accelerating express service, and it will be seen that such acceleration is not merely a matter of popular interest, but one that calls for very serious and anxious consideration in order to satisfy the patrons of the road and to secure successful results for the operating and financial departments of the railway.

LETTERS TO THE EDITOR.

THE PROPOSED STEAM USERS' ASSOCIATION.

SIR: The contributions which have been asked from members of this and other companies, at the rate of $3 per boiler, for the purpose of investigating the production of steam, are sufficient to warrant the undertaking. The notifications will be sent out by Mr. George Atkinson, Secretary. The work will be organized at once, and the subscribers will from time to time receive reports of progress.

Boston, Sept. 2, 1895. Edward Atkinson.
President Boston Manfrs.' Mutual Fire Insurance Co.

UNIFORMITY OF METHODS IN TESTING WATER METERS.

(Continued from page 183.)

very lowest rates of flow, it would be advantageous, if the conditions would permit, to throttle at the inlet, leaving the outlet free; but it is essential in such cases that the pipe leading from the outlet side of the meter shall be so arranged as to keep the meter full of water, that is, under a minimum of back pressure. But in all regular bench tests the meter should be throttled at the outlet when tried for sensibility, as this is the condition under which the device must regularly operate.

Primary Rules to be Observed in Bench Testing.

Water should be turned on to an empty meter slowly, until completely filled.

It is preferable to run a small quantity through a meter before starting a test.

In all meters it is desirable to eject the air before testing. The most ready and efficient means to this end, when vent screws are not provided, is to turn the meter over a few times, when connected for the test, on its side, or upside down, in which position it should be operated to drive out the air displaced by the change of position. This precaution is usually not worth observing when setting the meter in regular circuit, as the entrained air will gradually be absorbed and ejected.

In testing by weight, when using a tank mounted upon a platform scale, if especially accurate results are desired, it is well to read the scale-lever as it swings to some arbitrarily fixed mark near its end; the reason for this being that the majority of such scales are "logy" when loaded and can often be read from one to three pounds in error.

In testing by tanks, provided with glass tubes, there is a source of error due to capillarity, the extent of which varies somewhat with the condition of the atmosphere and the observer and the degree of cleanliness of the inner surface of the tube. Thus with a clean surface and pure water, the end surface of the column will be concave, due to the attraction of the glass; whereas if the surface of the glass is greasy, this will

act to repel the water and the end surface of the column will be convex. On the whole, it is well to swab out such tubes occasionally, and a little alcohol on the swab will not hurt the job. In view of these conditions it is generally believed to be the most uniformly reliable procedure to read the height of the column from the center thereof, be it concave or convex. And this is an argument in favor of glass tubes of large diameter.

Where the most exacting results are desired from a meter in low-flow performance, the pressure should be maintained as nearly uniform as possible. If the pressure varies considerably, this may result either favorably or unfavorably, either to the maker or the purchaser. The reason for this is that a pulsating pressure, during sensibility flows, may produce different effects upon different meters.

When using the 1-64-in. or the 1-32-in. diaphragms, especially if the test is to be of long duration, it is well to insert a piece of sponge to prevent particles of grit from closing the perforation.

In all positive meters having hard rubber displacing members, more accurate results may be expected, at low rate performance, when the water used for the test is rather tepid than cold; the reason for this being that the normal co-efficient of expansion and contraction of hard rubber is greater than that of brass or composition. This fact is taken into consideration, occasionally, in the construction of meters. It is for this reason that a meter will often fail to operate freely by blowing when taken from a shelf in a warm room, but will be all right when cooled in water.

A meter which operates correctly at the higher and lower rates of flow, and fails on the sensibility trial, may often be corrected by simply reversing the meter and running it backward for a few minutes; as, if the cause of the difficulty was a slight foreign obstruction, this treatment will often remove it.

In a water meter, to ascertain its obstruction to the delivery, relative to the service pipe, proceed as follows: (1) Insert a piece of regular service pipe of the same nominal size and the same length as the meter, placing it in the same position and using the same couplings and packing-washers as are used when testing the meter. (2) Apply a diaphragm to the outlet as in regular testing, whose diameter is somewhat less than that of the bore of the spuds of the meter. (3) Then make a number of runs, each of exactly the same amount, and carefully record the time of each run. Thus, if you have made four runs of 10 cu. ft. each and the time of each flow is 2½ minutes, you will have an aggregate of 40 ft., divided by 10 minutes, equaling 4 cu. ft. a minute, the capacity of the pipe. Now insert the meter (or the several meters, successively, if the test is to be comparatively of kinds) in place of the piece of pipe, again being careful to use the same connections and packing-washers as in the instance of the pipe. Then proceed as before, and run the same quantity for the same number of tests and carefully record the time required for the delivery of each. Should you now have an aggregate of 40 ft. delivered in 12 minutes, in the case of one meter, then its relation to the pipe would be 10 divided by 12; that is, the meter would have a capacity equal to 83.3% of that of the pipe. If another meter should require 13 minutes, its capacity relative to the pipe would be 76.9%, and the first meter would have 8.3% greater capacity than that of the second. (83.8 — 76.9 ÷ 76.9 = 8.3%.)

In bench tests the usual trial runs are as follows: 1, 2, 5 and 10 cu. ft., the correct weight equalling, respectively, 62½, 125, 312½ and 625 lbs. Sensibility tests, because of the time required, are frequently made by tenths of a foot, each tenth being equal to 6¼ lbs., or approximately 3 quarts. In connection with the foregoing, the accompanying percentages (Tables II. and III.) may be of service.

Table II.—Percentage Table for Bench-Testing of Water Meters.

(1 cu. ft. = 62.5 lbs.)

Actual indication of meter, %.	Error %	Cu. ft. indicated by meter to lbs. of water found in tank. 1.	2.	5.	10.
	Over				
104.1	4.1	60.0	120	300	600
103.3	3.3	60.5	121	302	605
102.4	2.4	61.0	122	305	610
101.6	1.6	61.5	123	307	615
100.8	0.8	62.0	124	310	620
100.0	0.0	62.5	125	312	625
	Under				
99.2	0.8	63.0	126	315	630
98.4	1.6	63.5	127	317	635
97.6	2.4	64.0	128	320	640
96.9	3.1	64.5	129	322	645
96.1	3.9	65.0	130	325	650

Table III.—Percentage and Time-Rate Table for Fractional Sensibility or Leakage Tests.

Actual indication of meter, %	Error, %	1-10 cu. ft. indicated by meter to lbs. of water in tank.
	Over	
108.6	8.6	5.75
104.1	4.1	6.00
100.0	0.0	6.25
	Under	
96.1	3.9	6.50
92.5	7.5	6.75
89.2	10.8	7.00
86.2	13.8	7.25
83.3	16.7	7.50
80.6	19.4	7.75
78.1	21.9	8.00
75.7	24.3	8.25
73.5	26.5	8.50
71.4	28.6	8.75
69.4	30.6	9.00
67.5	32.5	9.25
65.6	34.4	9.50
64.1	35.9	9.75
62.5	37.5	10.00

One-tenth indication in 3 minutes equals a rate of 2 cu. ft. an hour; in 3½, 1.7; in 4, 1.5; in 4½, 1.3; in 5, 1.2; in 5½, 1.1; in 6, 1; in 6½, 0.92; in 7, 0.85; in 8, 0.75; in 9, 0.66; in 10, 0.60; in 11, 0.55; and in 12, 0.50.

In Bench Testing Which Should be the Standard of Reference, the Meter or the Quantity Found in the Tank?

Theoretically, there is hardly any question but that in running a trial quantity into a gage receptacle, the meter ought to be stopped when the amount intended to be indicated by the meter is in fact shown by the scale or tank; but practically this is not as convenient nor can as accurate answers be obtained ordinarily as when the quantity intended to be run is indicated, whether correctly or incorrectly, by the register of the meter. The reason for this view of the subject is that commercial water meters, even in the smaller sizes, are not adapted to be read to less than 0.1 cu. ft.; whereas any degree of refinement may be obtained in the scale. Hence, in the writer's opinion, all meter tests, especially when small quantities are run, should be by the meter. The importance of this in practice may be best understood by presenting a brief illustration.

Suppose 10 cu. ft., regarded as 625 lbs., to have been run in a tank, but that the hand of the register is "shy" of the zero mark, the actual extent of the error can only be judged; to accurately ascertain it, the meter must be operated until the hand reaches the dial-mark, and yet, by doing this, the exact reference quantity in the tank has been increased.

From these conditions and circumstances frequent misunderstandings have arisen; thus, as to whether when a meter was reported as "under" or "over," it, in fact, registered less than the tank or the tank more than the meter. All such misunderstandings would be avoided by concurrence in the following procedure and interpretation: (1) That the meter be run until the intended trial quantity is indicated by the register; (2) that when the quantity found in the tank is more than the amount indicated by the meter, it shall then be understood that the meter under-registers, or is "under"; (3) that when the quantity found in the tank is less than that indicated by the meter, then the meter over-registers, or is "over."

Should the Error of Meters be Recorded in Terms of Pounds or Percentages?

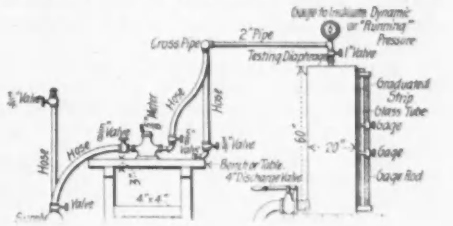
It is believed that it would be preferable if the indication of meters were uniformly denoted, on all test cards and records, in terms of percentage of the quantity indicated. This is now done in but comparatively few cases, the usual practice being to record the error in pounds, plus or minus, or in the percentage of error, plus or minus. These three methods of recording may be quickly brought clearly to mind by assuming a meter as indicating 10 cu. ft. but with 635 lbs. found in the tank. This can be recorded 635 — 625 = 10 lbs "under"; or 10 ÷ 635 = 1.6% minus; or 625 ÷ 635 = 98.4%, or the exact quantity registered by the meter. To the writer at least, in a column of tests, recorded in the latter way, it is more satisfying to the mind than in terms of pounds or differences.

Apparatus for Testing Water Meters.

In testing water meters, there are two reliable systems available—namely, by weighing the trial quantity, or by the use of a calibrated tank. In European practice, graduated tanks are largely, almost entirely, employed; in America, measurement by weight is most commonly in vogue. It is now believed by the writer that the graduated tank is the better system, in that there is less liability to error in observation; variations of volume due to the difference of temperature are obviated, and tests may be made in less time. There is no question, however, but that the weighing system is the cheaper to install, as with but a platform scale and an old oil barrel first-rate results may be obtained.

In Fig. 6 is shown one of the handiest, least expensive, and yet accurate testing systems known to the writer, consisting of a simple galvanized iron can, swung upon an iron axle from which, like the handle of a pail, it is suspended from a common spring balance scale having a total indication of 150 lbs. A tank, or can, 14 ins. in diameter by 24 ins. long will afford ample capacity for a test of 2 cu. ft. First-class results can be obtained from such an apparatus, especially where "fine-haired" testing is required. Thus within the range of the scale, 1 ft. can be run at full flow; ½ ft. at half rate; 0.2 or 0.3 at low, and as many more for the limit of sensibility.

In Fig. 7 is indicated a testing plant, in schematic detail, which may be of service as a starting thought to those who may regard the installation of a reliable, convenient and durable system as worth the while.



Maximum testing capacity, 10 cu. ft., or 75 U. S. gallons. 1 cu. ft. = 55 ins. height of column, nearly; 1 lb. = 3-32 ins., nearly; 1% = 1-16 in., nearly.

Fig. 7. Schematic Apparatus for Testing Water Meters by Graduated Tank.

Such an apparatus, adapted to the conditions of the place would be comparatively inexpensive and would be conducive to uniformly accurate results.

In the calibration of such a tank as is indicated in the plate, probably the most convenient and reliable method is by carefully weighing the water and graduating the scale from the water in the tube.

In the writer's practice a number of meters are tested in series, this being done to make time and save water. But, ordinarily, this would hardly be worth the extra cost of special fixtures. Moreover, this method involves special care and aptitude on the part of the operator to insure the ejection of air from the meters and an accurate comparison of the several indices of the registers.

THE MILWAUKEE WATER-WORKS INTAKE.

(With Inset.)

The new water supply intake tunnel for the city of Milwaukee, Wis., is one of the most difficult examples of tunnel construction which American engineering practice has afforded. The difficulties were in a large measure unexpected when the work was decided upon and put under way. The tunnel began and ended in a hard, impervious clay, practically a rock,, and all preliminary investigations led to the conclusion that the same favorable material would be encountered for its entire length. With such material a brick-lined tunnel 7½ ft. in diameter presented no unusual problems, but after about 1,640 ft. had been excavated from the shore end the tunnel ran out of the hard clay, and for the next 600 ft. or more a variety of water-bearing material was encountered, which tried the skill and patience of the engineer to their utmost. Other difficulties were indeed met with, but these were of minor importance in comparison with that of safely and successfully penetrating the water-bearing drift.

As a preliminary to a description of the work proper, a brief statement of the object of the tunnel and the general plan of the work is necessary. The water supply for the city of Milwaukee, Wis., had since 1874 been taken through a 36-in. cast iron pipe extending to a crib located in Lake Michigan 2,100 ft. from the shore. With the growth of the city this supply had gradually become insufficient, and in 1889 it was decided to construct an intake of greater capacity. The old intake had been laid in trench on the lake bottom, and protected by piles driven on each side, but for the much larger intake this method of construction was not deemed advisable. The bottom of the lake was very flat, and in order to get the intake at a safer depth, a very deep trench would have to be dredged. It was therefore decided to construct a short shore tunnel to a gate well, and then drive a longer tunnel out under the lake at a depth of 140 ft. below the lake surface, and end it in a shaft reaching to the surface, and afterwards to carry two lines of submerged pipe farther out to an intake crib. This work required about 3,200 ft. of tunnel, with the necessary shore and lake shafts, and 5,000 ft. more of cast iron intake, making altogether 8,200 ft. of submarine intake. Fig. 1 is a plan and profile of the intake as designed and constructed. The full lines show the tunnel as actually constructed, and the dotted lines the work as it was originally proposed to build it.

During 1889-90 contracts were let for the different portions of the work. Shailer & Schniglau, of Chicago, Ill., got the contract for constructing the shafts and tunnel and laying the submerged pipe; J. O'Neil, of Milwaukee, Wis., for building the lake shaft crib; C. H. Starke, of Milwaukee, Wis., for dredging the pipe trench and afterward for building the submerged intake crib, and the Addystone Pipe Co., of Cincinnati, O., for making the 60-in. cast iron pipe. The contract prices were as follows:

Constructing tunnel and shafts	$122,000
Laying submerged pipe	53,000
Dredging pipe trench	65,000
Constructing lake shaft crib	34,000
Furnishing cast iron pipe	126,000

After thoroughly overhauling the pumping machinery, the contractor again laid the tunnel dry on March 19, and after the pumps had been permanently placed so as to take care of the water, an examination of the work was made. It was found that the water was coming from the north, and with the hope of avoiding the difficulties of the old heading, it was decided to make a detour of the south. On April 16 work was begun at a point about 90 ft. back from the face and deflecting the line about 38° toward the south. About 38 ft. from the angle of junction a brick bulkhead with two 8-in. openings was built into the new bore. The work progressed successfully for about 75 ft., when water was again encountered, and upon pushing forward the heading, gravel and sand came in such quantities that it was found impracticable to continue the work further. On June 1 the bulkhead was permanently closed, and the work in this direction was abandoned.

A further and closer examination was now made of the heading first abandoned. Upon breaking through the rock-like clay it was found that the water came from an underground stream flowing from the north through a well defined channel in red clay. This channel was about 13 ft. above the grade of the tunnel, and above it in every direction visible was a bed of hard, dry, red clay, while immediately in front of the face of the work was a bank of coarse gravel. Fig. 1 shows the location of this underground stream, and Fig. 2 is a sketch of the channel and stream where they entered the work. In this last drawing the photograph has been followed exactly, no particular being exaggerated in the slightest. The water from this stream was clear and pure, and a chemical analysis showed that it was not lake water, but must come from some separate source.

While the engineer did not consider the difficulty of proceeding along the old line insurmountable, it was decided to be less difficult on the whole to go back from 150 ft. to 175 ft. and deflect the line to the north and upward, so as to pass over the underground entrance. Instead of allowing the water to flow at its normal rate and take care of it by pumping, the contractors desired to reduce the pumping, and to this end they constructed a bulkhead just west of the deflection toward the south with a view of shutting off the water. The water, however, accumulated with a pressure of some 50 lbs. per sq. in. and penetrated the filling around the brick lining of the tunnel, preventing the cutting through of the lining for the new line. A second bulkhead was then built about 20 ft. west of the first, but with not much better results, for upon closing it the water was found to leak through the brickwork for a long distance west. Finally on August 2, 1892, the contractors lifted their pumps and allowed the tunnel to fill again with water.

No further work was done on the tunnel by the contractors, although they continued work on the lake shaft for some months. Difficulties had, however, arisen here, which will be described further on, and finally a disagreement arose between the contractors and the city over the delay in prosecuting the tunnel work and over one or two other questions, which resulted in the City Council suspending their contract and ordering the Board of Public Works to go ahead with the work.

The first step to be taken by the engineer was to purchase adequate pumping machinery and empty the tunnel. This was effected Jan. 17, 1894, and as soon as practicable thereafter the two bulkheads were removed and the tunnel cleaned, tram car tracks laid, and everything prepared for work. It was now determined to go ahead on the original line of the tunnel if possible, and the bulkhead here was removed and work begun. Meanwhile, a safety bulkhead had been built to replace the first one torn away. This was provided with a door and drainage pipes. Work was begun on the original heading, but had proceeded only a little way when the water broke in, driving out the workmen. This was removed three or four times, when the flow suddenly increased to 3,000 gallons per minute. An examination of the lake bottom above the break showed that it had settled down, indicating that the new break connected with the lake bottom, and making further work along the original line out of the question.

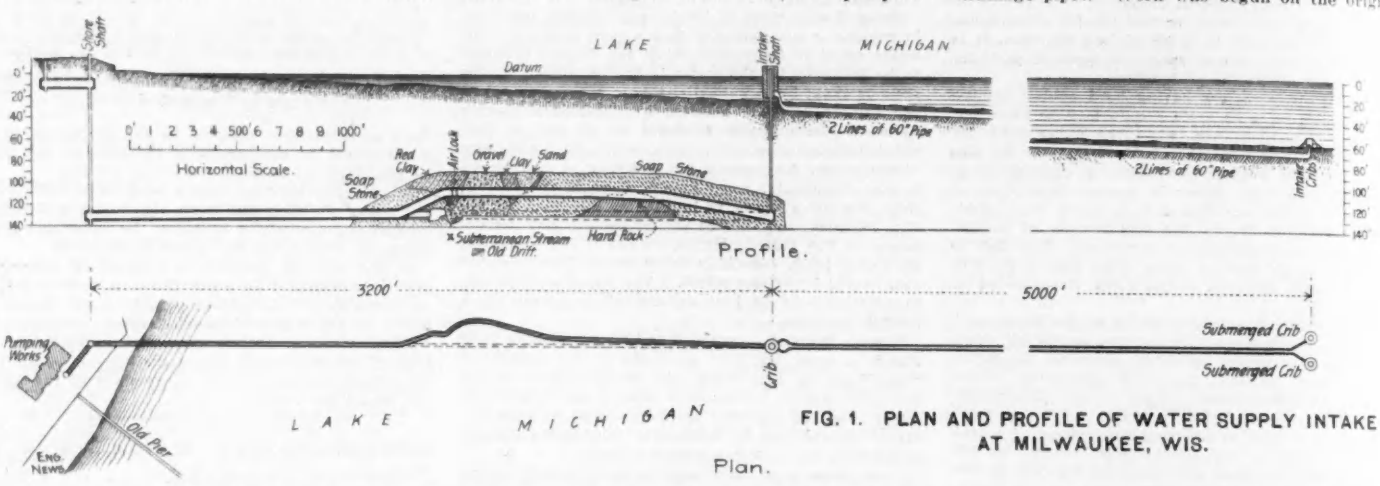


FIG. 1. PLAN AND PROFILE OF WATER SUPPLY INTAKE AT MILWAUKEE, WIS.

The question now arose what it was best to do. It was impracticable to use a shield, as the material ahead of the break required blasting and the pressure from above was enormous. On account of its expense and difficulty of application the freezing process did not seem advisable, and the plenum process was likewise out of the question on account of the great pressure which would be required at this depth. The detour to the south which had been made by the contractor had been unsuccessful, and had left the ground in a treacherous condition. To depress the tunnel was not advisable, for it was not by any means certain that the bed of gravel could be avoided in that way, and, moreover, it would be necessary to ascend again further on and thus leave a trap which would effectually cut off escape to those at work on the face if water again broke into the tunnel.

It was finally decided that the old plan of deflecting the line toward the north and upward so as to pass over the underground stream should be tried. A hole was therefore cut through the tunnel lining 1,433 ft. from the shore and work was begun on a detour of 20° toward the north and an upward grade of 10%. Fair progress was made on this new line, gradually ascending into solid rock, until May 10, when the test borings, which were constantly made in every direction from the face, showed that sand was being approached. A brick bulkhead was therefore built into the masonry as a safeguard, should it happen that water was encountered in large quantities. As the borings seemed to indicate that the top surface of the rock underlying the sand was nearly level, the lower half of the tunnel was first excavated, leaving about 18 ins. of the rock to serve as a roof (Sketch a, Fig. 3), and the brick invert was built for a distance of 52 ft. The rock roof was then carefully broken through for short distances at a time, and short sheeting driven ahead into the sand, which proved to be a very fine quicksand flowing through the smallest openings. Extreme care had to be taken in this work, but little by

The work of sinking the shore shafts and excavating the first 1,600 ft. of tunnel did not prove especially difficult. A hard, compact and rock-like clay, bearing very little moisture, was encountered all along, and was blasted and removed in the ordinary manner. The only mishap which occurred with this portion of the work was the destruction of the contractor's boiler plant by fire on Jan. 12, 1891, which allowed the tunnel to fill with water, and delayed work about a month. By Oct. 21, 1891, 1,640 ft. had been driven, averaging about 6⅔ ft. per day, all in the hard clay. No timbering had been necessary, and except for the first 100 ft. of the tunnel there was very little seepage. On the afternoon of Oct. 21, water was observed coming from one of the drill holes in the heading, but no attention was paid to it. Shortly after a blast was fired and was immediately followed by a rush of water from the heading. An unsuccessful attempt was made to check the flow, and the pumps were started, but they were unable to keep the water down, and after seven hours' hard work the tunnel was abandoned. By the next morning the tunnel and shaft were full of water.

Several attempts were made to empty the tunnel, but the limited pumping capacity was not equal to the task, and it was finally decided to instal larger pumps. The pumping had, however, shown that about 1,000 gallons of water a minute was coming through the leak. With the increased pumping plant the tunnel was finally laid dry Feb. 13, 1892. Upon examination the head of the drift was found to be in the same undisturbed condition in which it was left when the water broke in three months before.

A brick bulkhead was built into the end of the brickwork of the tunnel, and provided with a timber door for passage, and two 10-in. pipes for the outlet of the water. With these openings closed, the flow was checked sufficiently to allow the placing of pumps at the bottom of the shore shaft. Meanwhile the pressure of the water against the bulkhead caused dangerous leakage, and so after the pumps were in position the 10-in. pipes were opened, relieving the pressure and allowing the water its normal rate of flow. Trouble with the pumps now arose, and after various stoppages and breaks the discharge pipe finally fell, disabling the whole plant. It became necessary to close the 10-in. pipes in the bulkhead and draw up the pumps. This allowed the tunnel to again fill with water.

little the brickwork was pushed ahead until at a distance of 90 ft. from the point where the sand was first met, and 208 ft. from the old tunnel, the sand stopped and the heading entered a hard clay.

All this work had been done on an ascending grade, and the ascent was continued about 40 ft. farther in the clay. By this time a sufficient elevation was gained to pass over the underground stream, and the tunnel line was changed to head

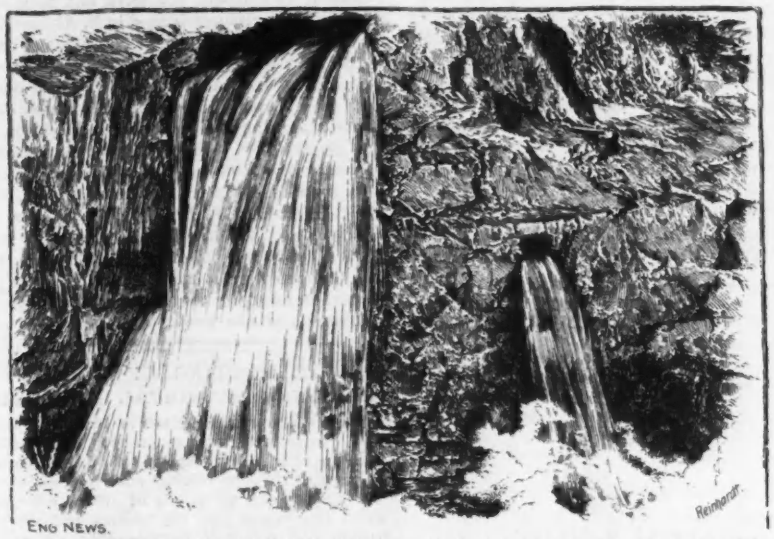


FIG. 2. OUTFLOW OF UNDERGROUND STREAM ENCOUNTERED IN DRIVING TUNNEL FOR WATER SUPPLY INTAKE; MILWAUKEE, WIS.

toward the lake shaft, and the grade reduced to a level. The underground stream was passed without trouble and the tunnel continued for a distance of 54 ft. without difficulty. On July 10 the clay in the heading suddenly softened, and before the miners could secure it by bracing, the water rushed in, followed by gravel, filling up solidly some 34 ft. of the tunnel before it was stopped by a timber bulkhead hastily built.

Upon examining the lake bottom a cavity over 60 ft deep and 10 ft. in diameter was found directly over the end of the tunnel, which had been caused by the gravel breaking into the tunnel. Having now reached an elevation where it was possible to use compressed air, it was determined to put in double air locks and use the plenum process. The locks were built and some 670 cu. yds. of clay was dumped into the hole in the lake bottom. On Aug. 4 the air locks were tried with 26 lbs. air pressure, but, upon a temporary release of the pressure, the water passed around the locks and back of the tunnel lining for some distance, and even forced through the lining, carrying considerable clay and fine sand with it. Upon sounding the lake bottom it was found that the cavity had again increased to a depth of 65 ft., whereupon an additional 600 cu. yds. of clay were dumped into it.

On account of the water leaking through the brickwork, the only dry place to cut through the brickwork and build in an air lock was just ahead of the brick bulkhead. This lock was completed Aug. 27, and to avoid encountering the danger of the direct connection with the lake at the end of the drift, it was decided to make another detour to the north. On Aug. 28, therefore, the brick on the north side of the tunnel 12 ft. back from the end of the brickwork was cut through under 25 lbs. air pressure, and work proceeded in good, hard clay. The original air lock was cut out and a new lock built into this clay about 34 ft. from the last detour, to be used in case of further difficulties. After building the tunnel for about 80 ft. from the detour, the soundings again indicated the approach to gravel and water, and on Oct. 14 the water broke through from the bottom in such volume and with such force that the men ran out, closing every air lock and the valves of every drain in their haste to escape, until the brick bulkhead was reached. It was with great difficulty that the portion of the tunnel up to the last air lock was recovered and cleaned out.

It was now recognized that a pressure of from 38 to 40 lbs. of air would be needed to hold this water, and accordingly another compressor was added to the plant. With a pressure of 36 lbs. the water was driven out and the work again started. At this time also an additional 350 cu. yds. of clay was dumped into the hole in the lake bottom. Altogether 1,620 cu. yds. of clay had been put into this hole.

Loose gravel and boulders, some of immense size, were now encountered, and the work became exceedingly difficult on account of the great escape of air. The interstices between the gravel and boulders were not filled with silt or sand, but contained water. Moreover, this material extended upward to the lake bottom, as was shown by the escape of air at the surface of the lake. For an area of several hundred square feet the surface of the water resembled a pot of boiling water. At times the air would escape very rapidly, and again only a few bubbles would show. Fig. 1 shows the location of this gravel bed, and from the nature of the boulders, which were sometimes of granite, and sometimes of trap and other formations foreign to the locality, and the glacial scratches on them, it appeared to have been formed by glacial action.

It need hardly be said that the work in this gravel was very slow. It was impossible to blast or to tear out the large boulders whole, as so much surface would be exposed that an inrush of water would take place despite the air pressure. The method of procedure was to excavate a heading and build the brick roof arch first, and then to take out the bench and build the invert. Fig. 3 gives a number of sketches showing how the work was done. A short piece of heading was taken out, the top and face of the bench being meanwhile plastered with clay (sketches b and c, Fig. 3) to reduce the escape of air, and then the roof arch was built and supported on side sills resting on the bench. Bit by bit the roof arch was pushed forward until some little distance had been completed, then the heading was plastered with clay and the bench taken out little by little and the invert built. All the gravel except the small area upon which work was actually in progress was kept thoroughly plastered with clay, and as the air escaped through the completed brick work very rapidly, water was allowed to cover a portion of the invert (see Sketch c, Fig. 3), so as to reduce the area of escape.

When a large boulder was reached, which lay partly within and partly without the tunnel section, the lining was built out and around it, as shown in Sketch d, Fig. 3. The boulder was then broken and taken out. All through this gravel bed the cross section of the lining is made irregular by the construction of these pockets in the lining to get around boulders. Sometimes they were on one side and sometimes on the other, or on both, or at the top or bottom. In fact, there was no regularity. Despite the hazard and danger of this work, continual progress was made, though sometimes it was only 4 ft. of completed tunnel per week, working night and day, and, if some cases of caisson disease be excepted, the only mishap occurring was a fire which got into the timber packing behind the lining and caused some trouble. From the gravel the tunnel ran into clay and quicksand, and then into hard, dry clay similar to that encountered near the shore. Some difficulty was had with the quicksand, but it was successfully overcome, and when the hard clay was struck the trouble as far as the work from the shore shaft was concerned was virtually over.

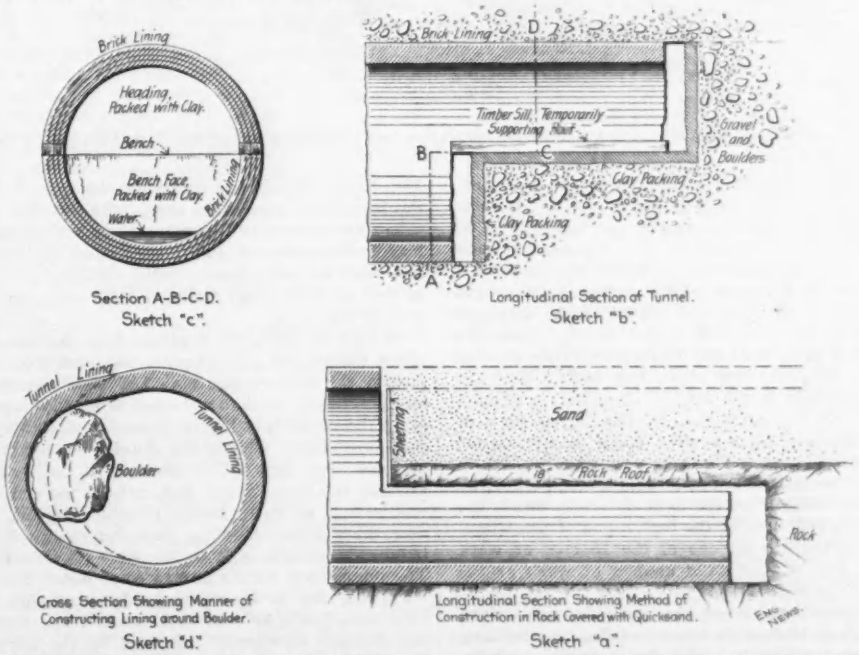


FIG. 3. SKETCHES SHOWING METHODS ADOPTED IN CONSTRUCTING TUNNEL THROUGH DIFFICULT MATERIAL.

Meanwhile, a different set of afflictions had come upon the engineer and contractors in sinking the lake shaft and driving the heading toward shore. The location of the lake shaft is shown in Fig. 1. This shaft was intended to be built by sinking a cast iron cylinder 10 ft. in diameter, made up of sections bolted together. Work was begun July 5, 1892, and the sinking was accomplished first by weighting the cylinder and afterward by pumping

out the sand and water within it until the pressure from the outside broke through under the cutting edge and forced the sand into the cylinder, allowing it to sink a little. From 10 to 30 cu. yds. of sand were carried into the cylinder each time, and finally it was feared that if the process continued, the crib, which had been previously erected, would be undermined. On Sept. 6, therefore, the contractors were ordered to discontinue this method of work. No change was made, however, until Oct. 1, when the cylinder had reached a depth of 68 ft., and by this time there was quite a large cavity underneath the crib. This was refilled, and the cylinder pumped out, and excavation begun inside of it. On Oct. 11 a 2½-ft. deep ring of brick work was laid underneath the cutting edge, but in trying to put in another ring beneath the first, two days later, the sand and water broke through the bottom, driving the men out and filling the cylinder to a depth of 16 ft. with sand. The pumps were started, but the water could not be lowered to a greater depth than 60 ft.

abandoned by the contractors some time before, as has already been described, the city suspended their contract on Oct. 19.

On Oct. 30 a contract was made with Mr. Thos. Murphy, of Milwaukee, Wis., to sink a steel cylinder inside the old iron cylinder. The water was first pumped out of the old cylinder and a timber bulkhead built at the bottom. On this the steel cylinder was built, and then the bulkhead was removed. Air pressure was put on, and the excavation proceeded successfully until the bottom layer of clay was met with, when all chances for trouble ceased. At one time the cylinder tilted a little out of plumb, but this was easily rectified.

The cylinder, as it was completed, penetrated 9 ft. into the hard clay, and was underpinned with brickwork for a depth of 29 ft. or more, to a point 4 ft. below the grade line of the tunnel. At the lower end, the section of the shaft was changed from a circle to a square, as shown by Fig. 5. Later the steel cylinder was lined with brick.

On March 28, 1894, an agreement was made with

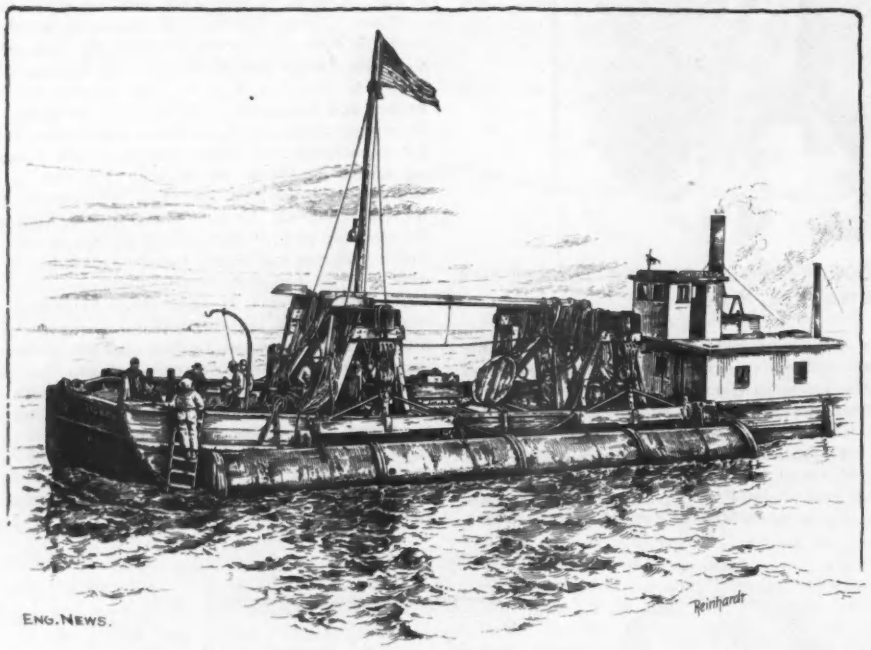


FIG. 11. SKETCH SHOWING METHOD OF TOWING CAST IRON PIPE FOR SUBMERGED INTAKE.

At the request of the contractors the city engineer had a boring made at the center of the shaft to determine the character of the material to be further penetrated. This boring showed that sand mixed with loam and gravel would be found for a depth of 26 ft., then would come 15 ft. of red clay, and finally a layer of hard clay like that penetrated by the shore end of the tunnel. About the middle of December the contractors made another attempt to pump the shaft, but finding that the water came in at the rate of 25 gallons a minute, abandoned the attempt. In the latter part of February preparations were made to put an air lock in the shaft and use compressed air. Hardly had the work been begun by this system, when, on April 20, 1893, a terrific easterly storm swept the top of the crib bare of the buildings and machinery and drowned all but one of the 15 men at work there. Fig. 4 shows the method of work at the time of the accident.

This disaster delayed the work for some time, but in June the contractors erected a new building and new machinery, and resumed work, very little progress was made, and the air escaped so rapidly that it loosened the sand surrounding the shaft and reduced the friction to such an extent that on July 28 the entire cylinder lifted bodily about 6 ft., and sand rushed in, filling the lower part of the cylinder to within 45 ft. of the lake surface. No farther work was done by the contractors, although they submitted a proposition to sink a steel cylinder inside the cast iron cylinder and extending from 5 ft. above datum to 100 ft. below datum for $300 per ft. This proposition was refused by the city, and since work on the tunnel proper had been Mr. Thos. Murphy to construct the tunnel from the lake shaft toward the shore. Except that considerable water was encountered, which, owing to inadequate pumping machinery, filled the tunnel and shaft at two different times, and had to be removed, no very great difficulty was had with this part of the work.

On July 28, 1895, the headings from the lake and shore shafts met. Meanwhile the cast iron pipe intake, the intake crib, etc., had been completed and practically all that remained to be done was to clean the tunnel and lift the pumping machinery at the shore shaft. During the cleaning the air pressure has been kept up on account of the leakage through the brick lining, and, indeed, the pressure will be kept up until the last possible moment, and everything made ready for removing the air locks, bulkheads, pumps, etc., in the least possible time. The pumps will be the last to come out.

Turning now to the crib and submerged pipe construction, it will be seen that most of the general features are sufficiently indicated by the illustrations. Fig. 6 shows the construction of the lake shaft crib, and Fig. 7 that of the submerged intake crib. Figs. 8 and 9 show details of the pipe construction, and Fig. 10 some of the shaft and well connections with the tunnel.

There were two lines of 60-in. cast iron pipe laid as shown by Fig. 1. A trench was first dredged in the lake bottom, and the pipe laid by a diver in 50-ft. lengths. The four sections forming a length of pipe were connected on shore, and then, with their ends closed, were towed to the point where they were to be sunk by a barge, as shown by Fig. 11. The spigot end of each 50-ft. length was fitted with a temporary hub and poured with lead before it left shore. After it was entered into the hub end of the preceding section laid, the divers pulled the joint tight by means of the clamps shown in Fig. 8. As much as 200 ft. of pipe was laid in this manner in one day. The two cribs were built on shore, towed to their positions and filled and sunk. The various other details of the crib and pipe construction are shown clearly by the illustrations.

Taken as a whole, the work has been extremely trying to all persons engaged in it. Altogether 15 men have lost their lives on the work, of which number 14 were drowned by the storm sweeping over the crib, and two died from the effects of compressed air. Not a single life was lost in the various accidents attending the dangerous excavation through the glacial drift. This reflects great credit, as do the skill and ability with which the whole work was conducted, upon the City Engineer, Mr. Geo. H. Benzenberg, M. Am. Soc. C. E., who had the whole work in charge. Altogether the work has been a costly one, about $575,000 having been expended upon it from first to last. We are indebted to Mr. Benzenberg for much aid in preparing this description of the work.

ANNUAL MEETING OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

This society was organized in Buffalo in September, 1894, "to promote information upon, and to discuss the best methods to be employed in the management of, all municipal departments and the construction of municipal works, by means of annual conventions for social intercourse and the reading and discussion of papers upon municipal improvements, and to circulate, by means of annual publication among its members, the information thus obtained."

The second annual convention met in Cincinnati, O., at 10 a. m., Sept. 11, with about 250 delegates and visitors in attendance, and Vice-President G. H. Benzenberg, of Milwaukee, presiding officer. After an announcement of the programme of entertainment by Mr. August Herrmann, President of the Board of Administration of Cincinnati, Mayor Caldwell was introduced and formally welcomed the delegates. Referring to the objects of the society, he said:

The wisdom of a convention of this character is self-evident. You meet to exchange ideas and views and present facts, in order that the most potent, practical and advanced methods may be adopted for the better government of municipalities. As representatives of the different cities throughout the country, you convene to get broader and better ideas of the best way to prosecute the work devolving upon you in your different official capacities; to consider how to secure the best and purest water supply at the cheapest cost; how to beautify your cities with parks and breathing places; how to secure and maintain efficient police and fire departments; how to provide your city with sufficient light at the lowest cost; how to pave, clean and repair your streets and alleys; to secure for your people the best possible street-car service; regulate sanitation and prevent disease; how to best lessen taxation—in other words, how to conduct the affairs of public office for the highest and best interests of the people whom you serve.

The progress of a city largely depends upon the broadness, the integrity and the efficiency of her public officials.

Mr. Benzenberg, in replying to Mayor Caldwell, said:

Our society is on the threshold of a great and useful future. When it first met one year ago there were present only the representatives of 13 cities, and it was very doubtful what its future would be. We are meeting to-day with a representation of 70 cities and 250 delegates. They are the men whom the people have entrusted with the great public works in which every year more than $100,000,000 is expended.

The object of our society is to promote their efficiency by gaining from the knowledge and experience of others and by enlightening them that they may be able to avoid the dangers, risks and errors in which so many have fallen and which have resulted in loss and detriment to the cities. It is to be noted that so many of the younger cities are alive to these facts. Instead of blundering along in the old way, at great cost to themselves, they are sending their delegates here to learn what is best and newest and successful in public works, and they will build their future on the knowledge so obtained.

This means, in the first place, economy; public works will be built in the most economical manner and in the best manner for the health, comfort and enjoyment of the people. It is for this we shall labor here.

Reading the minutes of the last meeting was dispensed with and the second article of the constitution—on membership—evoked such a lively and important discussion that the consideration of the entire subject of the constitution and proposed amendments was referred to a committee to report the following day.

A paper was then read by Mr. W. G. Wilkins, City Engineer of Allegheny, Pa., on "Specifications for Brick Paving," in which he said:

I have made a study of specifications for paving brick in other cities, and the first question that I hoped to have answered by my investigations was: "What are the requirements of a first-class paving brick?" and second, "What are the tests necessary to

determine if the bricks come up to these requirements?" I found almost as many opinions as there were specifications in this regard. I believe that engineers should have certain and well-defined ideas as to what materials are fit for a particular work on which he may be engaged; also, what tests are necessary to determine the fitness of these materials, and that the specifications must specifically state what the requirements will be. . . . The author's purpose in writing this paper has been to call attention to the importance of standard tests for paving brick, and if it shall in any degree assist in preparing such standard tests its purpose will have been accomplished. There has been a committee of the National Brick Manufacturers' Association appointed to prepare a standard specification for paving brick, and which has already held one meeting. It might be well for this society to appoint a committee to co-operate with the manufacturers' committee, and by such co-operation, a standard specification could be secured which would be acceptable both to the manufacturer and the engineer. If this were done there would possibly result a specification which would be fair to both, and the manufacturers could not then say that the engineers had prepared specifications which were impossible to comply with, and the engineer could not say that it was a manufacturers' specification and the requirements not rigid enough.

There was no information essentially novel elicited in the short discussion which followed; the general sentiment was evidently favorable to the extension of brick paving. The meeting adjourned at noon so that the delegates might be ready at 1 p. m. to take a carriage drive about the city.

The carriage drive came off in accordance with the programme, and, barring the excessive heat of the day, was very enjoyable; it ended at 5 p. m. at the entrance to the Zoological Gardens, where refreshments were served, the attractions inspected, a very excellent fireworks display witnessed, and a very fine band listened to.

The first business of the second day was the adoption of the constitution as amended, which allows any municipality in America to be eligible to membership on paying $5 fee, said municipality to have as many members in the society representing boards or departments of said municipality as may be desired, without any additional admission fee, but upon payment of the dues hereinafter prescribed.

Municipalities are not required to pay any annual dues, but each individual representing any department of a municipality that has acquired a membership in the society must pay $3 per annum as dues, on or before the date of the annual meeting.

It provides also that there shall be "Associate Members," having all rights except those of being officers and of voting, such associate members being those who have ceased to be city officials, but who desire to retain their connection with the society.

Mr. John W. Hill, M. Am. Soc. C. E., the well-known Cincinnati hydraulic engineer, read a paper on "Public Water Supply," upon the subject matter of which he was called to answer numerous questions. Mr. Hill has made the purification of water a special study and is one of the most enthusiastic and untiring investigators of this important subject. His paper was printed in full in the Cincinnati "Enquirer" of Sept. 13.

Mr. W. H. Holton, President of the Board of Public Works, Indianapolis, read a short paper on the "Municipal Improvements of Indianapolis" during the past four years.

That city has been revolutionized, he said, since the new charter of 1891, which took its public affairs out of partisan politics—a curse in many municipalities, but especially so in Indianapolis, The Mayor appoints the three municipal boards, not more than two members of any board of the same party.

In 1891 there were less than two miles of improved roadways in the city. To-day it has 45 miles of improved streets, of which 25 miles are asphalt, 15 miles brick, and the remainder of cedar block and macadam.

Last year there were constructed some six or seven squares of cedar cylindrical block pavements. This pavement has been down a sufficient time to demonstrate it is not desirable. They are laying some two miles of cedar block pavements in Indianapolis this season, but the blocks are rectangular.

There is a growing sentiment in favor of asphalt as against brick, and it is now an exception when a brick pavement is laid on any of the principal resident or business streets of the city.

Indianapolis has 60 miles of sewers, completed at a cost of over $1,500,000, of which amount the sum of $848,839.05 has been spent by the department in the past four years perfecting the new system.

In the discussion which followed, and which was almost exclusively devoted to the merits of various kinds of pavement and paving materials, City Engineer Cappelen, of Minneapolis, gave some interesting personal experience with Utah asphalt, which he believes to be equal to the Trinidad. Ten years' guarantees are given with it. Its introduction in that city brought the cost to the city down from $2.75 to $2.49, $2.05 and $2 per square yard.

Mr. H. E. Bailey, of Newark, read a short description of the Newark water supply, which he represented as the ideal water system of America.

The afternoon was spent in inspecting the electric street car system of Cincinnati. A special train of seven cars was run over a very extended route, and as many delegates as survived the roasting heat of the sun and the "hospitalities" of the Moerlein brewery and the Elm St. Club, adjoining it, reached their hotel in time for supper.

At the business meeting, held at 7 p. m., the following officers for the ensuing year were elected: President, G. H. Benzenberg, Milwaukee; Vice-Presidents, Wm. R. Kerr, Chicago; August Herrmann, Cincinnati; Jas. C. McGann, New Haven; Secretary, D. L. Felton, Allegheny, Pa.; Treasurer, John L. Kennedy, Nashville, Tenn. It was decided that the convention of 1896 should be held in Chicago.

At the session held at 10 a. m. Friday, it was announced that 110 members had paid fees and dues, and they alone had the right to vote and take part in the proceedings.

Mr. Thos. J. De Vilbiss, Chairman of the Department of Public Works, Fort Wayne, Ind., read a paper on the "Disposal of Garbage," in which he advocated complete incineration of all garbage and against the reduction processes.

Mr. O'Shea, of Buffalo, favored reduction. Buffalo objects to the contract system, and says it has been a failure, and it pays $35,000 for reduction. Garbage receptacles cannot be placed in the streets, but in yards. Garbage is disinfected, as are the receptacles every time they are emptied. Ashes, etc., are kept in separate receptacles. Refuse is hauled from 2½ to 7 miles. Ashes are hauled further. There are not 150 vaults in Buffalo, the public sewers being in general use. This speaker had evidently made a study of garbage disposal, and by his familiarity with statistics and general information on the subject easily took the first place.

Mr. Harrison Van Duyne, of Newark, N. J., read a paper on "Paving," in which he referred to the recent introduction of brick pavement on the streets of that city.

Mr. Harper, of Akron, O., said that toughness was the most desirable quality in a paving brick. To secure it, he thought that annealing or slow cooling of the bricks after firing was essential.

Mrs. Dr. Mary Donahue, of Davenport, Ia., was granted the privilege of the floor to read a short paper on the "Physical Condition of School Children," after which Mr. John Jones, Street Commissioner of Toronto, Canada, read a paper on "Street Cleaning." Toronto has 14 miles of asphalt, 115 miles of cedar block, and 80 miles of macadam streets which are kept cleaned, the balance, 45 miles, being unpaved. The city appropriates $50,848 for the work annually, and last year $32,500 was used. The work is done by rotary sweepers, and on asphalt from May to December by the orderly system, also known as the block system, each man cleaning a quarter of a mile a day. For watering streets, contracts are made with the railroad company to sprinkle with a trolley tank car the track space, 16 ft. 6 ins. wide, and 85 miles long, at 30¼ cts. per mile. Ordinary wagons sprinkle the rest of the streets. Asphalt streets are not sprinkled. Water injures the asphalt. The electric car system of sprinkling has been in use two years, and is satisfactory. Garbage is cremated, and ashes are to be hauled to low land by trolley cars. The city cleans the snow in front of the property whose owners do not do it, assessing the cost to the property, and collecting it with taxes.

Mr. Abram Joralemon, of Newark, N. J., Chairman of the Committee on Street and Highways, read a short paper upon "Street Work in Newark."

The following resolution, offered by John L. Kennedy, of Nashville, Tenn., was adopted:

Resolved: That it is the sense of this meeting that the welfare of American cities is more dependent upon the intelligence and integrity of their public officials than upon the local supremacy of any political party, state or national.

Mr. Harold P. Brown, of Newark, N. J., read a paper showing how electrolysis affected the water pipes in his city, and how the evil was corrected.

Committees were appointed as below, and the final adjournment was then taken:

Finance—L. W. Rundlett, St. Paul; T. J. O'Brien, Oswego, N. Y.; W. H. Glore, Covington, Ky.
Sewerage and Sanitation—R. E. McMath, St. Louis; G. L. Clausen, Chicago; George N. Fernald, Portland.
City Government and Legislation—D. E. Wright, Cleveland; C. C. Brown, Indianapolis; J. McConkey, Harrisburg, Pa.
Street Paving—A. D. Thompson, Peoria; Nelson P. Lewis, Brooklyn; S. J. Hathaway, Marietta.
Garbage—John S. O'Shea, Buffalo; Lyman H. Johnson, New Haven; Dr. J. W. Prendergast, Cincinnati.
Electric Street Light—J. A. Cabot, Cincinnati; Harold P. Brown, Newark, N. J.; F. W. Cappelen, Minneapolis.
Taxation and Assessment—G. F. Munroe, Omaha; Thomas De Vilbiss, Ft. Wayne; Charles P. Sayre, Camden.
Water-Works and Water Supply—H. Van Duyne, Newark, N. J.; E. H. Keating, Toronto; S. C. Hathaway, New Bedford.

In the afternoon there was a fine display of the efficiency of the Cincinnati Fire Department, followed by a joint parade of the fire and police forces and machines. In the evening the convention banquet was held at the Gibson House.

The steel armored cruiser "Maine" went into commission on Sept. 16. She is at present the most powerful war vessel in the American Navy. The "Maine" was commenced in 1888 at the Brooklyn Navy Yard, and was launched on Nov. 18, 1890; the long interval since then is accounted for by delay in receiving her armor-plates. The contract dimensions were as follows: Length, 318 ft.; beam, 57 ft.; mean draft, 21½ ft.; displacement, 6,648 tons; 9,000 maximum I. H.P. The contract speed was 17 knots, but her trial trip showed 18.37 knots per hous without her heavy guns. Her 12-in. armor belt is 180 ft. long, and her 6-in. guns are protected by 2-in. plates. Her main battery contains four 10-in. guns in two barbette turrets covered with 8-in. armor, and six 6-in. guns; her secondary battery consists of eight 6-pdrs., eight 1-pdrs. and four Gatling guns. The hull and machinery cost $2,484,000.

The total length of railways in operation in India on March 31, 1894, was 18,855 miles, an increase of 355 miles during the year, while 2,217 miles were under construction or sanctioned. The operating expenses amounted to 46.98%, as compared with 47.14% for the previous year, and the return on capital expenditure was 5.09%, as compared with 5.46%. Of the total mileage, 10,875¾ miles are of the Indian standard gage (5 ft. 6 ins.), 7,712 miles of meter gage and 267½ miles of special narrow gages. The number of passengers increased 7.53%, and the number of passengers carried per mile was 315,085, of which 97.43% were in the lower classes, 2.19% in the second-class and only 0.38% in the first-class cars. The average journey per passenger was 40.09, 48.92 and 75.03 miles for the respective classes, and the average amount paid 1.59, 0.635 and 0.29 cts. per mile for the lower, second and first classes, respectively. The freight carried showed an increase of 13.16%, the ton-mileage 9.87%, and the earnings, 6.78%. The tons carried per mile amounted to 260,074. The average number of passengers per train was 219.12 on the standard gage and 236.18 on the meter gage lines. The lowest average cost of hauling a passenger one mile was 0.075 ct.; the average receipts per passenger were 0.26 ct. The lowest average cost of hauling one ton of freight one mile was 0.2 ct., the average receipts for this work being 0.62 ct.

ANNUAL MEETING OF THE NEW ENGLAND WATER-WORKS ASSOCIATION.

The 14th annual convention was held in Burlington, Vt., Sept. 11, 12 and 13. About 200 members and guests were in attendance. The meeting opened on Wednesday forenoon with Mr. Geo. A. Stacy, President of the association, in the chair. A brief address of welcome was made by the Hon. U. A. Waterbury, Governor of Vermont. The report of the treasurer showed a balance on hand of $2,673. The secretary, Mr. John C. Whitney, reported a net gain of over 40 in membership during the year, there having been 487 members on June 1, 1895, of which 401 were active, 5 were honorary, and 81 associate members. Negotiations for permanent headquarters are being made in conjunction with the Boston Society of Civil Engineers.

The first paper read was by Mr. F. H. Crandall, Superintendent of the Burlington Water Department.

The Water System of Burlington.

The works of the Burlington Aqueduct Co. were bought by the city about 1865. The supply was then taken from springs collected in a covered brick reservoir. The source was soon changed to Lake Champlain, and the works were greatly enlarged. Recently a new intake of 24-in. cast iron pipe has been laid for about three miles into Lake Champlain, and the old intake near the dock line has been abandoned. Flexible Falcon joints were used on this work, one for every six lengths, or 75 ft., the joints taking up 3 ft. This intake was described and illustrated in Engineering News of June 21, 1894. Meters were used by the company, and the city now has about 1,200 in service. Alcatraz asphalt has been used as a preservative on both the inner and outer sides of the high-service tank, with good success, but only a portion of the tank has been so covered. This tank is supplied by a hydraulic motor (described in Engineering News, Oct. 1, 1887), driven by water from the low-service reservoir. For each 20 gallons passing the motor one gallon is forced into the high-service system.

In discussing the paper some remarks were made on the durability and stoppages of service pipes, and Mr. Allen Hazen presented some ideas regarding the use of the same lake for a source of water supply and for sewage disposal. He suggested that in attempting to decide how much money should be expended in specific cases to prevent water pollution, a comparison should be made between the value of lives lost through impure water and the cost of improvements. At $5,000

per life the 2,000 deaths from typhoid fever in Chicago in 1891 would be represented by $10,000,000, to say nothing of the loss occasioned by the 18,000 estimated cases.

Electrolysis.

The paper with the above title, by Prof. H. A. Storrs, of the University of Vermont, was a good resume of a subject which has been given much space in these columns during the past few years.

Some court decisions bearing indirectly on this matter indicate that street railway companies may be held liable for damages to underground pipes caused by the currents of the company, when proper provision is not taken to avert such action.

Mr. Winslow, in discussing the paper, thought that even with the double trolley there will be leakage, and as slight currents may do damage, he urged that only in storage batteries is there safety. Mr. Peter Milne objected to connecting return wires with underground pipes, on the ground, apparently, that measures should be taken to render this unnecessary.

The Water Supply of Lynn.

The first paper of the afternoon was by Mr. John C. Haskell. He described in detail the water-works of Lynn, Mass., which have recently been extended so as to collect water from 22 sq. miles of drainage area, as against five square miles prior to 1894. Water from the Saugus River and its tributaries flows by gravity to a pump well, from which it is lifted to low and high-service reservoirs. In the business portion of the city 1,000,000 gallons of water per hour can be supplied for fire purposes without reducing the pressure below 40 lbs. The purity of the water is indicated by a typhoid death rate of about two in 10,000, which is low for cities of the size of Lynn in this country. Weekly samples of water are taken from the various ponds at different depths, and subjected to bacteriological examinations. Water can be drawn from five different sources, and from varying depths,so that with the aid of the examinations named it is possible to avoid the use of water of disagreeable taste and odor, which sometimes develops. A part of one of the ponds has been cleared of organic matter and graveled. The author promised to give a paper on this phase of the works at a later date.

Bench Testing of Water Meters.

We present elsewhere in this issue an abstract of a paper by Mr. John Thomson, M. Am. Soc. C. E., on the testing of water meters. This paper brought out much discussion, as papers on meters generally do. In this case, the main point at issue was the degree of accuracy which should be sought in a water meter. A number of members expressed themselves as satisfied with meters coming within 5 to 8% of accuracy, but many others desired as great accuracy as possible, within reasonable limits, in order that small leaks might be detected. Mr. H. G. Holden asked if durability is not better than extreme accuracy, when 50 gallons of water is worth only 1 ct., with water at 20 cts. per 1,000 gallons. Mr. J. C. Chase said that the functions of a meter are two: To make possible an apportionment of charges for water, and to act as an automatic check against waste.

Wednesday evening was devoted to stereopticon lectures. Mr. Crandall supplemented his morning paper by some views of the Burlington water-works, and Prof. W. T. Sedgwick entertained and instructed the audience with an illustrated talk on

The Sanitary Condition of the Burlington Water Supply.

The speaker began by stating that the Burlington water-works is one of the very few, if not the only one in New England which draws its water supply from the same lake into which it empties its sewage. But while it is peculiar among the water-works of New England, it resembles closely in this respect the supplies of such cities as Chicago, Milwaukee, Buffalo, Cleveland, Duluth and many other places outside of New England.

In 1892 so much uneasiness was felt in regard to the sanitary condition of this water supply that Professor Sedgwick, who for some time before had been making occasional bacterial examinations of the water, for the water board, was invited by them to make a thorough study of the entire sanitary problem. He found, somewhat to his surprise, that the vital statistics of the city showed it to have been remarkably free for many years from deaths attributable to polluted drinking water. A closer study led him to believe that this immunity was largely due to the fact that beyond the sewer outfall was a small bay, or basin, in which, at the seasons when diarrhoeal diseases were most likely to prevail, the sewage naturally stood, for a time, before passing on into the lake. Time was thus gained for the germs of disease to settle, or to die, or otherwise to disappear. But it was his opinion that if, as was then proposed, the sewer should be carried out to the lake front, the danger of contamination of the water supply would be greatly increased.

Furthermore, while it was certainly true that deaths from typhoid fever and similar diseases were very few in Burlington, it was stated by physicians, and believed by the people, that diarrhoea, though not of a fatal type, was more common than in most cities of similar character. Professor Sedgwick therefore made the following report:

In the present state of sanitary science there can be no doubt that the location of the intake is highly objectionable, if not positively dangerous. I can only regard it as a constant menace to the sanitary welfare of the city.

In 1894 the intake was removed to its present position, three miles from the sewer outfall, the latter having previously been extended to the lake front, thus, in the opinion of the speaker, very much enhancing the danger from the old intake. Professor Sedgwick lately had made an extensive series of bacterial analyses from all parts of the system, the sewer outfall and along the lake front, and these show in a striking manner the advantage of the removal of the intake. They will be published later. Actual cultures from various parts of the service were shown by the aid of the stereopticon. These, together with the vital statistics and the reports of physicians, prove that the sanitary condition of the water supply is now excellent, and there seems no reason to doubt that it will continue to be excellent for many years to come.

The St. Louis Water-Works.

Thursday was given up to an excursion, noted below, with the exception of an evening session, opened by Mr. Desmond FitzGerald, M. Am. Soc. C. E., with an illustrated description of the main features of the St. Louis water-works. In 1865 Mr. Jas. P. Kirkwood recommended the very source of supply, or rather the point on the Mississippi River for an intake, which after 30 years has been made available. The water commissioners recommended that water be taken from this point, the Chain of Rocks, but the city council disapproved this, asking why water should be brought over a long and devious course, when it could be taken in a short and direct one from Bissell's Point. The council not only disapproved the recommendations of the water commissioners, but asked for their resignation, which request was speedily granted.

Both the old and new works employ settling basins. About 90% of the suspended matter will settle 4 ft. in 24 hours. The water carries from 10 to 20 cu. ft. of solid matter in each 1,000,000 gallons. Last year about 220,000 cu. yds. of sediment was removed from the settling basins, at an average cost of 2⅛ cts. per yd. Some of the sediment is removed at slight cost by flushing, but the balance has to be taken out by manual labor.

At the close of the description of the St. Louis works, Mr. FitzGerald showed some views of the great Vyrnwy dam and reservoir, from which the water supply of Liverpool is drawn. The new works at St. Louis were described in our issues of April 18 and July 4, 1891; Feb. 20, 1892; Feb. 22, July 26 and Aug. 16, 1894.

The Advisability of Having Tests of Water Meters and Other Articles of Commerce Conducted by the Association.

In the absence of the author, Mr. Clemens Herschel, M. Am. Soc. C. E., the secretary read a paper contributed by him, with the title above given. The paper opened by references to the great testing laboratories of the Pennsylvania R.R. Co., at Altoona, and the tests made by the Master Mechanics and other associations. The author thought it desirable that this association should conduct various tests, and suggested that it begin on the several American types of household water meters. Last winter Mr. Herschel tested seven different makes of 1-in. meters for accuracy, loss of head and durability, and is now testing the effect of disuse. He found that the three meters which are cheapest in price gave the best results.

None of the members who discussed this paper favored the proposition that the association should make tests of articles of commerce, but there was a general agreement as to the desirability of adopting standards for tests. It was pointed out by Mr. A. F. Noyes, M. Am. Soc. C. E., that the Boston city tests of 1888 gave rise to some adverse criticism, and charges of favoritism, which were evidently ungrounded. Mr. J. C. Whitney stated further that the type of meter adjudged best by the Boston commission has never been known commercially, and that the second was but little better off. The tests cost some $10,000, or more, to make. Prof. Geo. F. Swain, M. Am. Soc. C. E., agreed with the other speakers that the society should avoid such tests as were advocated by the paper, and instead should attempt to lay down standards. This closed the proceedings of the second day of the convention.

The officers of the association for 1895-6 were elected at the opening of the morning session on Friday, as follows: President, Desmond FitzGerald, M. Am. Soc. C. E., Brookline, Mass.; Vice-Presidents, H. S. Sparks, Bangor, Me.; Chas. K. Walker,* Manchester, N. H.; F. H. Crandall,* Burlington, Vt.; Jos. E. Beals, Middleboro, Mass.; Thos. McKenzie, M. Am. Soc. C. E., Southington, Conn.; Willard Kent, Woonsocket, R. I.; Secretary, John C. Whitney,* Newton, Mass.; Treasurer, Geo. E. Batchelder,* Worcester, Mass.; Senior Editor, Allen Hazen, Boston; Junior Editor, Walter H. Richards,* New London, Conn.; Executive Committee, John C. Haskell,* Lynn, Mass.; H. G. Holden, Nashua, N.H.; R. C. P. Coggeshall, New Bedford, Mass; Finance Committee, A. R. Hathaway,* Springfield, Mass.; A. W. F. Brown, Fitchburg, Mass.; Wm. McNally, Marlboro, Mass.

*Re-elected.

A Short History of the High Service of Manchester, N.H.

This paper was presented by Mr. Chas. K. Walker, of Manchester. The Manchester high service was described in our issue of Sept. 5.

The selection of the place for holding the next annual meeting was, by vote of the association, left to the executive committee with power, as was also the securing of permanent headquarters.

Views of the New Works at Waterbury, Conn.

The hall was sufficiently darkened to permit Mr. R. A. Cairns to show stereopticon views of the new dams and gravity pipe line for these works. The new reservoir is formed by a masonry dam 90 ft. high above the base of the foundations, and an earth dam to cut off a side valley. The dam is curved, with a 600-ft. radius. The lower part of the masonry dam was built with Alsen Portland cement. Mr. Cairns stated that he never used cement with better results. The unfinished dam was flooded during the past winter, which was a very severe one. The pipe line is of 30-in. cast iron, with a Venturi meter at the dam. Curves were laid without specials, the prescribed limit being 15°, but in two cases 17° was reached. The pipe line on a bridge was left uncovered, and no bad results were experienced during the winter. In leaving the pipe uncovered for testing during the summer crawling was prevented by placing boards over it, 7,000 ft. B. M. serving for about one-half mile.

Calorific Determination of the Value of Fuel.

Mr. Geo. H. Barrus, M. Am. Soc. M. E., read a paper on this subject, accompanied by an exhibition of an actual calorimeter test of a sample of Pocahontas coal. The calorimeter tested has been used by Mr. Barrus for the past five years. A table of results of tests was included in the paper. Considerable interest was shown in the subject by the members, who asked a number of questions, which were answered by Mr. Barrus.

Attaching and Care of Water Meters.

This practical paper was read by the secretary in the absence of the author, Mr. R. C. Bacot, Jr. It described in some detail the fittings and methods employed in setting meters. New meters should be tested before setting, and only 1% of error should be allowed. A waterphone should be provided each meter reader for the detection of leaks. It is desirable that meter superintendents should visit the meter departments of other cities, and that meter inspectors and repairers should visit meter manufactories and familiarize themselves with the methods of repairing those in use. There was no discussion on this paper, partly due to the lateness of the hour. The idea of holding an afternoon session was abandoned, also owing to the lateness of the hour, and the meeting adjourned to the final session in the evening.

The Metropolitan Water Supply for Boston and vicinity was described briefly on Friday evening by Mr. A. F. Noyes, M. Am. Soc. C. E. These works, which are just being put under construction, were described at length in our issue of March 7, 1895. This finished the reading of papers, one prepared by Mr. Chas. A. Hague, M. Am. Soc. M. E., on the "Operation of Pumping Plants by Electricity," being read by title, only, in the absence of the author.

The Excursions.

Several excursions were provided for the members and guests, and were highly enjoyed by those who participated in them. On Wednesday the ladies in attendance went by Lake Champlain to Fort Ticonderoga as guests of the National Meter Co., of New York. Other excursions were provided, as given below, by the citizens of Burlington, in conjunction with Messrs. R. D. Wood & Co., of Philadelphia, the Chapman Valve Co., of Indian Orchard, Mass., the Hersey Manufacturing Co., of Boston, and the Thomson Meter Co., of Brooklyn: On Thursday an all-day excursion by boat and rail to Ausable Chasm and to Hotel Champlain, Bluff Point, N. Y., lunch being served at the latter place; on Friday morning, by carriage to the Burlington water-works reservoirs and about the city; on Friday afternoon, by electric cars to Fort Ethan Allen, where the operation of a Pohle air-lift pump and a cavalry drill were seen.

Just before adjourning votes of thanks were given to those who had helped make the convention a success, and to retiring officers. To Mr. F. H. Crandall, for a number of years one of the Vice-Presidents of the association, and Superintendent of the water-works of Burlington, Mr. R. C. P. Coggeshall presented on behalf of members of the association a set of Bancroft's "History of the United States," in six volumes, and Irving's "Sketch Book," in two volumes. The convention adjourned at about 9 p. m., in time to take the night trains for Boston and New York. About 30 new members were elected during the convention, which brings the total membership up to nearly 520.

*Re-elected.

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PERSONALS.

Mr. Walter A. Miles, of Mount Vernon, N. Y., has been nominated for State Engineer and Surveyor on the Prohibition ticket.

Mr. Charles F. Mattes, Third Vice-President of the Lackawanna Iron & Steel Co., died at Scranton, Pa., Sept. 3, at the age of 76.

Mr. Campbell W. Adams, of Utica, N. Y., State Engineer and Surveyor, has been renominated for this position on the Republican ticket.

Mr. Kirby, Chief Engineer of the U. S. battleship "Texas," has been detached from duty on account of prostration of health due to overwork.

Prof. C. V. Riley, formerly Entomologist of the U. S. Department of Agriculture, died at Washington, D. C., Sept. 14. He was born in London in 1843.

Mr. James Murry, Vice-President of the Northwest Central R. R., and a contractor of large experience on the Welland canal and other public works, died at St. Catharines, Ont., recently.

Mr. H. J. Simmons, an engineer of the Texas State Railroad Commission, has been appointed Chief Engineer of the Galveston, La Porte & Houston R. R., in place of Mr. F. H. Peters, resigned.

Col. H. S. Haines, M. Am. Soc. C. E., has resigned his position as Vice-President of the Plant System of railways, on account of his acceptance of the position of Commissioner of the Southern Traffic Association.

Mr. E. Sherman Gould, M. Am. Soc. C. E., sailed Sept. 14 for Venezuela, in the interest of a projected railway in that country. He expects to return by Oct. 18. His permanent address remains at Yonkers, N. Y.

Mr. J. M. Turner, Superintendent of the Central Division of the Southern R. R., with office at Raleigh, N. C., has resigned in order to accept the position of Superintendent of Transportation and Motive Power of the New Orleans & Western R. R., with office at New Orleans, La. Mr. Johnston T. Busbee, Superintendent of the Southern Division, will succeed Mr. Turner.

Mr. H. P. Taussig, M. Am. Soc. C. E., has resigned his position as Chief Engineer of the Terminal R. R. Association of St. Louis, Mo., and the office has been abolished. Mr. N. W. Eayrs, M. Am. Soc. C. E., Superintendent of Structures, will have charge of repairs and renewals to bridges, buildings, interlocking plant, etc.; and Mr. J. W. Taylor has been appointed Engineer of Maintenance of Way.

Mr. Preston K. Yates, M. Am. Soc. C. E., of New York city, has been engaged by Mr. Isaac A. Hopper, contractor for the Third Ave. bridge, to superintend his work on the bridge. During the past five years he has superintended the construction of the 155th St. viaduct and the new McComb's Dam bridge for Mr. Alfred P. Boller, M. Am. Soc. C. E., and the Harlem Ship Canal bridge for Mr. Wm. H. Burr, M. Am. Soc. C. E., and has since been Resident Engineer for the contractor for the foundations of the New York Central R. R. bridge over the Harlem River.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

INTERNATIONAL DEEP WATERWAYS ASSOCIATION.
Sept. 24, 25, 26. Annual convention, at Cleveland, O. Vice-Pres., L. E. Cooley, Chicago, Ill.

WISCONSIN POLYTECHNIC SOCIETY.
Sept. 24. Secy., W. K. Means, Loan & Trust Bldg., Milwaukee.

ENGINEERING ASSOCIATION OF THE SOUTH.
Sept. 26. Secy., H. D. Ruhm, Nashville, Tenn.

INDIANAPOLIS ENGINEERING CLUB.
Sept. 28. Secy., C. C. Brown, City Engineer.

AMERICAN SOCIETY OF RAILROAD SUPTS.
October. Annual meeting at New York. Secy., C. A. Hammond, 143 Liberty St., New York.

COLUMBIAN ENGINEERING SOCIETY.
Oct. 1. Secy., W. F. Hart, University Building, 15th and H Sts. N. W., Washington, D. C.

WESTERN SOCIETY OF ENGINEERS.
Oct. 2. Secy., Chas. J. Boney, 1736 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Oct. 2. "Moving Two 36-in. Water Mains Without Shutting Off the Water," by E. C. Moore. Secy., C. W. Hunt, 127 E. 23d St., New York city.

ENGINEERS' CLUB OF ST. LOUIS.
Oct. 2. "The Continuous Rail in Street Railway Service," by Richard McCulloch. Secy., W. H. Bryan, Turner Blk.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Oct. 4. Secy., O. H. Von Geldern, 819 Market St., San Francisco.

ENGINEERING CLUB OF COLUMBUS, O.
Oct. 5. Secy., David Buell.

ENGINEERS' CLUB OF PHILADELPHIA.
Oct. 5. Secy., L. F. Rondinella, 1122 Girard St.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Oct. 8. At Atlanta, Ga. Secy., R. W. Raymond, New York, N. Y.

ROADMASTERS' ASSOCIATION OF AMERICA.
Oct. 8. At St. Louis, Mo. Secy., W. W. Sharpe, Waycross, Ga.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
Oct. 8. Secy., F. A. Coburn, Case Library Building.

DENVER SOCIETY OF CIVIL ENGINEERS.
Oct. 8. Secy., H. Breen, 36 Jacobson Block.

NORTHWEST RAILWAY CLUB.
Oct. 8. Secy., G. A. Seley, 80 Metropolitan Block, St. Paul, Minn.

NORTHWESTERN SOCIETY OF ENGINEERS.
Oct. 8. Secy., D. W. McMorris, Burke Bldg., Seattle, Wash.

NEW ENGLAND RAILROAD CLUB.
Oct. 9. Secy., F. M. Curtis, P. O. Box 1576, Boston, Mass.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Oct. 10. Secy., C. H. McLeod, Montreal.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Oct. 10. Secy., G. L. Annan, City Engineer's Office.

ENGINEERING SOCIETY OF WESTERN NEW YORK.
Oct. 10. Secy., Geo. R. Sikes, 122 Pearl St., Buffalo, N. Y.

ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
Oct. 10. Secy., Jas. K. Zollinger, Norton Building.

MONTANA SOCIETY OF CIVIL ENGINEERS.
Oct. 12. Secy., Forrest J. Smith, Denver Block, Helena, Mont.

ENGINEERS' CLUB OF KANSAS CITY.
Oct. 14. Secy., F. W. Tuttle, Baird Building.

AMERICAN INT. ASSOC. OF RY. SUPTS. OF BRIDGES AND BUILDINGS.
Oct. 15. At New Orleans, La. Secy., S. F. Patterson, Boston & Maine R. R., Concord, N. H.

AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 15. At Montreal, Que. Secy., John N. Partridge, Brooklyn, N. Y.

AMERICAN INSTITUTE OF ARCHITECTS.
Oct. 15, 16, 17. Annual convention, at St. Louis, Mo. Secy., Alfred Stone, Providence, R. I.

WESTERN RAILWAY CLUB.
Oct. 15. Secy., W. D. Crosman, Rookery Bldg., Chicago.

AMERICAN RAILWAY ASSOCIATION.
Oct. 16. At New York. Secy., W. F. Allen, 24 Park Place, New York.

ENGINEERS AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
Oct. 16. Secy., F. Van Vleck, Los Angeles, Cal.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Oct. 16. Secy., S. E. Tinkham, City Hall, Room 36, Bromfield St.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
Oct. 16. Secy., J. A. Pilcher, Roanoke, Va.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Oct. 16. Secy., R. W. Pope, 26 Cortlandt St., New York.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Oct. 17. Secy., D. Carhart, Carnegie Library Bldg., Allegheny.

ENGINEERS' CLUB OF CINCINNATI.
Oct. 17. Secy., J. F. Wilson, Odd Fellows' Temple.

NEW YORK RAILROAD CLUB.
Oct. 17. Secy., John A. Hill, 256 Broadway, N. Y.

ENGINEERS' CLUB OF MINNEAPOLIS.
Oct. 21. Secy., E. Nexson, Kasota Block.

CENTRAL RAILWAY CLUB.
Nov. 8. Secy., H. D. Vought, Buffalo "Courier," Buffalo, N. Y.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 21. Secy., C. A. Charpiot, Macon, Ga.

NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Dec. 13. Secy., D. W. Meeker, St. Paul, Minn.

CIVIL ENGINEERS' CLUB OF CLEVELAND.—At the meeting on Sept. 10 Mr. F. S. Barnum presented a paper on "Educational Architecture," dealing not with school buildings, but with the educating influence of architecture. F. A. Coburn, Secy.

AMERICAN INTERNATIONAL ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.—The Secretary, Mr. S. F. Patterson, Philadelphia, Pa., has issued the following information regarding the meeting to be held at New Orleans, La., Oct. 15, 1895:

The convention will meet at the Hotel Grunewald, which is located on Baronne St., near Canal St. The hotel expenses will be $2.50 per day for each person, including parlors for the meeting of the Association, and suitable committee rooms. It is desired that rooms be engaged 10 days in advance. Members should apply for transportation through their general management in advance. Pay for Pullman accommodations going, taking a receipt for same, and a free pass will be given returning, by presenting same with credentials to Mr. J. C. Morrison, District Supt. at New Orleans.

WESTERN RAILWAY CLUB.—The first meeting of the club, after the summer vacation, was held at the Auditorium Hotel, Chicago, Sept. 17, and was followed by a banquet in the evening. With this meeting the club practically began its year's work for 1895-6. The meeting opened with a discussion on "Car Heating," based on the paper read by Mr. Jas. F. McElroy, Consolidated Car Heating Co., at the May meeting (Eng. News, June 13, 1895). This was followed by topical discussions on "Grab-Irons and Handholds and Drawbar Heights," and "Exhaust Pipes and Steam Passages; Their Relation to Locomotive Economy." The paper of the day described a compound locomotive test on the Chicago & Northwestern Ry., and was presented by Mr. Storm Bull, M. Am. Soc. M. E., Professor of Mechanical Engineering, University of Wisconsin. The main points of interest in the paper and discussions we shall give in a future issue.

NEW PUBLICATIONS.

GRAVITATION AND COSMOLOGICAL LAW: A Mathematical Demonstration of the Secret of Gravitation and Attendant Phenomena, by M. T. Singleton, Rockmart, Ga. Published by the author. 8vo; pamph; pp. 23.

A BRIEF REVIEW OF RAILROAD HISTORY, from the Earliest Period to the Year 1894. By W. Hasell Wilson, Hon. M. Am. Soc. C. E. Philadelphia: Allen, Lane & Scott. Boards; 12mo; pp. 53; 25 cts.

This little book is a handy compilation of the principal events and dates which have marked the development of the railway systems of the world, and more especially those of the United States, this being the only country whose railways are considered in any detail.

MASTER CAR BUILDERS' ASSOCIATION. Report of the Proceedings of the Twenty-Ninth Annual Convention, held at Alexandria Bay, N. Y., June 11, 12, 13 and 14, 1895. Secretary, John W. Cloud, Rookery Building, Chicago, Ill.; 8vo; cloth; pp. 437; plates 15; illustrated.

This is a complete report of the proceedings, giving in full the several reports of committees and the discussions thereon, the standards of the Association now in force, and also the records of cases submitted to the arbitration committee. A report of the proceedings of the convention was given in our issues of June 13 and 20, 1895.

REPORT OF THE CHICAGO, MILWAUKEE & ST. PAUL RY. CO., for the Year Ending June 30, 1895. Secy., P. W. Myers, Milwaukee, Wis. Paper; 8vo; pp. 33.

The report of the Board of Directors shows net earnings of $10,291,616, the operating expenses being 62.35% of gross earnings, as compared with 64.21% in 1894, and 66.34% in 1893. The average rate per ton per mile was 1.075 cts., and the rate per passenger per mile was 2.396 cts. Liberal expenditures upon the property during recent years, the cheapness of track material and the reduced volume of traffic have made it possible to reduce maintenance and operating expenses. Better financial results are expected for the current year.

THE PITCH LAKE OF TRINIDAD. By S. F. Peckham. Reprinted from the "American Journal of Science." Pamphlet; 8vo; pp. 19.

The writer describes the early discovery and accounts of the pitch lake, giving several quotations from these accounts, and then describes his visit to the lake, discussing this natural phenomenon from a geological rather than an engineering point of view. The working part of the tramway for cars carrying the material from the lake to the ships is laid upon palm leaves (some of which are 25 ft. long) laid on the surface of the pitch. The writer considers that the terms "lake" and "land" asphalt express a distinction without a difference.

TRADE PUBLICATIONS.

DRAWING INSTRUMENTS.—Eugene Dietzgen Co., Chicago, Ill. Paper; 5¾ × 8¾ ins.; pp. 10; illustrated.

This is a pamphlet containing illustrated descriptions of the special details of the instruments made by this firm, and having also a brief price list.

ENGINEERING STRUCTURES.—Wilkins & Davison, Engineers, Pittsburg, Pa. Oblong, 9 × 6 ins.; plates 22.

This is a set of well-executed half-tone views of bridges, viaducts, furnace plants, tipples, etc., of which the firm issuing the pamphlet were the engineers.

DERRICKS AND HOISTING PLANT.—American Hoist & Derrick Co., St. Paul, Minn. Paper; 6¾ × 10 ins.; pp. 168; illustrated.

This is a trade catalogue and price list covering numerous classes of derricks, hoisting engines, boilers, wire rope, pulleys, etc. It includes hand, steam, horse and electric power hoisting plants, and large derricks with steel masts and booms. There are several half-tone views showing the company's plant in use on different public works.

CRANES.—The Brown Hoisting & Conveying Machine Co., Cleveland, O. Paper, 6 × 9 ins.; pp. 83; illustrated.

This catalogue contains nearly 60 half-tone illustrations of the various kinds of traveling, jib and pillar cranes, derricks, transfer tables, crabs, winches, etc., now manufactured by this firm. Accompanying each illustration there is a brief description of the size of the machine, its power, speed of operation, etc., giving such general information as will give a clear understanding of its capacity and construction.

AIR-BRAKES.—Hunt Air-Brake Co., Pittsburg, Pa. Cloth, 5¼ × 6¾; pp. 56; illustrated; folding cover, with plates and diagram in pocket of cover.

This is an instruction book for the maintenance and handling of the Hunt air-brake system for cable and electric cars. The air-pump is worked by an eccentric on one of the car axles and charges a reservoir, maintaining automatically a pressure of 40 lbs. per sq. in. From the reservoir the air is led through a motorman's valve to the double-piston cylinder, the piston rods being connected with the usual system of brake and floating levers. The brake is already in use, and we shall publish a description of it shortly.

ASPHALT BLOCK PAVING.—Hastings Pavement Co., Hastings, N. Y., and New York city. Paper; 5¾ × 9⅛ ins.; pp. 43; illustrated.

This pamphlet is devoted to the description of pavements made of compressed asphalt blocks. The manufacture of paving blocks from crushed stone and Trinidad asphalt is said to have been begun at San Francisco in 1869. The blocks now used are usually 4 × 5 × 12 ins., and weigh 22½ to 24 lbs. each. The surface of a street paved in this way is noiseless, but is not smooth and slippery, and is said to be easier for horses than a sheet asphalt pavement. The Hastings block paving has been laid in several cities in this country, and is in use also in Caracas, Venezuela; Sydney, Australia; and the City of Mexico. Asphalt tile paving with tiles 8 × 8 ins. square and 2½ ins. thick, has also been largely used for sidewalks, park paths, courtyards, etc. Several favorable reports from engineers and others are given in the pamphlet.

HISTORY OF THE PORTLAND CEMENT INDUSTRY IN THE UNITED STATES.—American Cement Co., Philadelphia, Pa. 8vo; pamph.; pp. 113; illustrated.

While this is, properly speaking, a trade publication, it includes a very interesting review of the general history of Portland cement from the experiments of Smeaton, in 1759, down to and including its manufacture in the United States. While Smeaton arrived at the true principle of hydraulic cements, in his studies for the Eddystone Lighthouse, it was Parker who, in 1796, found the desired mineral elements combined in nodules of septaria from which the first natural cement known to commerce was made. Somewhat later Sir C. W. Paisley found that an artificial mixture of clays and fat limes would, after calcination, produce hydraulic cement. But the first practical output of what is now known as Portland cement was due to the efforts of Joseph Aspdin, a bricklayer of Leeds, England. He took out a patent for his process in 1824, and established a small works, and by combining English chalk with river-bed clay, drying the mixed paste and calcining this in closed kilns, he produced a cement of great strength and hydraulic character, and founded a vast industry.

In the United States, somewhere in the "forties," the building of the locks, walls and bridges of the canals of that period developed the manufacture of hydraulic cement from natural rock found near Rondout, on the Hudson River. This discovery was rapidly followed by the opening of other deposits of similar rock on the Lehigh River, at Siegfried's Bridge, near Hancock and Cumberland, in Maryland, and at Louisville, Kentucky, and the establishment of manufactories of natural cement. Portland cement, from England, found its way into commercial use in this country shortly after the civil war, and until 1876 all cement of this character used in the United States came from abroad. But Mr. David O. Saylor, of Lehigh county, Pa., in connection with Mr. John W. Eckert, after many and discouraging experiments, succeeded finally, in 1878, in mastering the problem set them, and they established the first commercial and successful Portland cement works in the United States. At a later date Mr. Eckert established at a short distance from this oldest plant the first factory of the American Cement Co., which now has four factories, with a present combined capacity of 2,000 barrels of Portland cement per day.

The bulk of this publication is devoted to the detailed tests showing the excellence of the American product, and to an exhibit of its uses in some of the most important engineering and architectural structures erected in this country. The book is filled with most striking reproductions of these structures, and from an artistic and typographical standpoint it is an excellent example of the best type of modern American trade publications.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Sept. 20.	Steel supports, etc.,	Chicago, Ill.	Aug. 22
Sept. 20.	Passenger elevator,	Paris, Tex.	Sept. 5
	Advertised, Eng. News, Sept. 5 and 12.		
Sept. 20.	Pipe sewers,	Greenfield, Ind.	Sept. 5
Sept. 20.	Bridge, Niagara Falls,	N. Y.	Sept. 12
	Advertised, Eng. News, Sept. 12.		
Sept. 20.	Paving,	Rochester, N. Y.	Sept. 12
Sept. 20.	Cement sidewalks,	Dayton, O.	Sept. 12
Sept. 20.	Railway (35 miles),	Lima, O.	Sept. 12
	Advertised, Eng. News, Sept. 12 and 19.		
Sept. 20.	Pipe sewers,	Troy, N. Y.	Sept. 12
Sept. 20.	Macadam road,	Voluntown, Conn.	Sept. 12
	Advertised, Eng. News, Sept. 12 and 19.		
Sept. 20.	Water-works,	La Grange, Ill.	Sept. 19
Sept. 20.	Gravelling,	Washington, D. C.	Sept. 19
Sept. 21.	Water-wks. plans,	Tippecanoe City, O.	Sept. 12
	Advertised, Eng. News, Sept. 12 and 19.		
Sept. 21.	Cement sidewalks,	Indianapolis, Ind.	Sept. 12
Sept. 21.	Macadam road,	East Windsor, Conn.	Sept. 12
Sept. 21.	Water bonds,	St. Charles, Minn.	Sept. 12
Sept. 21.	Pipe sewers (2,500 ft.),	Indianapolis, Ind.	Sept. 12
Sept. 21.	Bridge abutm'ts,	Council Grove, Kan.	Sept. 12
Sept. 21.	Water bonds,	Kentland, Ind.	Sept. 19
Sept. 21.	Macadam road,	East Haddam, Conn.	Sept. 19
Sept. 23.	Lighting court house,	Decatur, Tex.	Aug. 29
Sept. 23.	Bridge,	Wabash, Ind.	Aug. 29
Sept. 23.	**Pier work, etc., in**	**Delaware River.**	**Sept. 12**
Sept. 23.	Sidewalks,	South Bend, Ind.	Sept. 12
Sept. 23.	School building,	Scranton, Pa.	Sept. 19
Sept. 23.	Plans for county building,	Detroit.	Sept. 19
Sept. 23.	Water-wks. resev'rs.	Colorado Springs.	Sept. 19
Sept. 23.	Grading,	Syracuse, N. Y.	Sept. 19
Sept. 23.	Brick sewer,	Syracuse, N. Y.	Sept. 19
Sept. 23.	Constructing sidewalks,	Salt Lake City.	Sept. 19
Sept. 23.	Paving,	Baltimore, Md.	Sept. 19
Sept. 23.	Iron bridge,	Marysville, O.	Sept. 19
Sept. 23.	Fire department house,	Boston, Mass.	Sept. 19
Sept. 24.	Electric r'y franchise,	Los Angeles, Cal.	Aug. 29
Sept. 24.	Library bldg. work,	Washington.	Sept. 12
Sept. 24.	Steel bridge,	Worthington, Minn.	Sept. 12
Sept. 24.	Electric wiring,	Ellis Island, N. Y. H.	Sept. 19
Sept. 24.	Macadamizinz,	Bristol, Conn.	Sept. 19
Sept. 24.	Telford road,	South Windsor, Conn.	Sept. 19
Sept. 24.	Armature, etc.,	Philadelphia, Pa.	Sept. 19
Sept. 24.	Macadam road,	Windsor, Conn.	Sept. 19
Sept. 24.	Armory roof,	Montreal, Que.	Sept. 19
Sept. 24.	Naval supplies,	Washington.	Sept. 19
Sept. 24.	Brick sewers,	Jersey City, N. J.	Sept. 19
Sept. 24.	Paving,	Jersey City, N. J.	Sept. 19
Sept. 25.	Sidewalks,	Elkhart, Ind.	Sept. 12
Sept. 25.	Improving street,	Hoboken, N. J.	Sept. 12
Sept. 25.	Macadam road,	Preston, Conn.	Sept. 12
	Advertised, Eng. News, Sept. 12.		
Sept. 25.	Pipe sewers (12,000 ft.),	Woodstock, N. B.	Sept. 12
	Advertised, Eng. News, Sept. 12.		
Sept. 25.	Macadam road,	Brooklyn, Conn.	Sept. 19
Sept. 25.	Macadamizing,	Stonington, Conn.	Sept. 19
Sept. 25.	School building,	Superior, Wis.	Sept. 19
Sept. 25.	Ditch (17 miles),	Monticello, Ind.	Sept. 19
Sept. 25.	Improving streets,	Chicago, Ill.	Sept. 19
Sept. 26.	Water-wks. system,	W. Carthage, N. Y.	Sept. 12
Sept. 26.	Macadam road,	Pomfret, Conn.	Sept. 12
	Advertised, Eng. News, Sept. 12.		
Sept. 26.	Road,	Ansonia, Conn.	Sept. 12
	Advertised, Eng. News, Sept. 12.		
Sept. 26.	Reservoir,	Bristol, Va.	Sept. 12
Sept. 26.	Bank building,	Grafton, W. Va.	Sept. 12
Sept. 26.	Laying water pipe,	Elmwood, Ill.	Sept. 12
	Advertised, Eng. News, Sept. 12.		
Sept. 26.	Water-works system,	Garrett, Ind.	Sept. 19
	Advertised, Eng. News, Sept. 19.		
Sept. 26.	Macadam road,	Putnam, Conn.	Sept. 19
	Advertised, Eng. News, Sept. 19.		
Sept. 26.	Crushed stone,	New York, N. Y.	Sept. 19
Sept. 26.	Public building work,	Brooklyn, N. Y.	Sept. 19
	Advertised, Eng. News, Sept. 19 and 26.		
Sept. 26.	Public building found's,	Newburg, N. Y.	Sept. 19
Sept. 26.	Electric light plant,	Garrett, Ind.	Sept. 19
	Advertised, Eng. News, Sept. 19.		
Sept. 26.	Sewers,	Brooklyn, N. Y.	Sept. 19
Sept. 26.	Ext'n to p'm'p'g station,	Norwood, O.	Sept. 19
Sept. 26.	Storm water sewers,	Putnam, Conn.	Sept. 19
	Advertised, Eng. News, Sept. 19.		
Sept. 27.	Barges,	Louisville, Ky.	Sept. 5
Sept. 27.	Museum building,	Milwaukee, Wis.	Sept. 12
Sept. 27.	Public building,	Allegheny, Pa.	Sept. 12
	Advertised, Eng. News, Sept. 12.		
Sept. 27.	Water-wks. system,	Cold Spring, N. Y.	Sept. 12
	Advertised, Eng. News, Sept. 12 and 19.		
Sept. 27.	Water-works system,	Kentland, Ind.	Sept. 19
Sept. 27.	Elec. lighting plant,	Grand Island, Neb.	Sept. 19
Sept. 27.	Pipe sewer, etc.,	Rochester, N. Y.	Sept. 19
Sept. 27.	Driveway in	Medford, Mass.	Sept. 19
Sept. 27.	Macadam road,	Plainfield, Conn.	Sept. 19
	Advertised, Eng. News, Sept. 19.		
Sept. 27.	Iron bridge,	Carthage, Mo.	Sept. 19
Sept. 27.	Water-works system,	Ripley, N. Y.	Sept. 19
	Advertised, Eng. News, Sept. 19.		
Sept. 27.	Granite block paving,	Brooklyn, N. Y.	Sept. 19
Sept. 27.	Trunk sewer (brick),	Kingston, N. Y.	Sept. 19
	Advertised, Eng. News, Sept. 19 and 26.		
Sept. 28.	Water-wks. system,	Ephrata, Pa.	Sept. 12
	Advertised, Eng. News, Sept. 12.		
Sept. 28.	Cement,	Washington, D. C.	Sept. 12
	Advertised, Eng. News, Sept. 12.		
Sept 28.	Electric lighting,	Homestead, Pa.	Sept. 19
	Advertised, Eng. News, Sept. 19.		
Sept. 28.	Macadam road,	Vernon, Conn.	Sept. 19
Sept. 28.	Melan arch bridge,	Ridgewood, N. J.	Sept. 19
Sept. 28.	Rock crushing plant,	San Francisco.	Sept. 19
Sept. 28.	Sewers,	Washington, D. C.	Sept. 19
	Advertised, Eng. News, Sept. 19.		
Sept. 30.	Water-works system,	Bond Hill, O.	Sept. 5
	Advertised, Eng. News, Sept. 5 and 12.		
Sept. 30.	School building,	Mark Center, O.	Sept. 12
Sept. 30.	Iron bridges (2),	Pottsville, Pa.	Sept. 12
Sept. 30.	Light station at	Cedar Point, Md.	Sept. 19
Sept. 30.	Belgian block paving,	Brooklyn, N. Y.	Sept. 19
Sept. 30.	Sewage disposal beds,	Plainfield, N. J.	Sept. 19
	Advertised, Eng. News, Sept. 19.		
Sept. 30.	Water bonds ($300,000),	Syracuse, N. Y.	Sept. 19
Sept. 30.	Hospital, etc.,	Newport, R. I.	Sept. 19
Oct. 1	Plans for art building,	Philadelphia, Pa.	May 23
	Advertised, Eng. News, May 23 to June 27.		
Oct. 1.	**Composite gunboats,**	**Washington, D. C.**	**Aug. 1**
Oct. 1.	Pipe sewers,	Appleton, Wis.	Sept. 19
Oct. 1.	Water-works system,	Laurens, N. Y.	Sept. 19
	Advertised, Eng. News, Sept. 19 and 26.		
Oct. 1.	Supplies for Mare Island navy yard.		Sept. 19
Oct. 1.	Pipe sewers,	Pontiac, Mich.	Sept. 19
	Advertised, Eng. News, Sept. 19.		
Oct. 1.	Bridge substructure,	Marinette, Wis.	Sept. 19
Oct. 1.	Water-wks. system,	Mt. Sterling, O.	Sept. 12
	Advertised, Eng. News, Sept. 12.		
Oct. 1.	Dredging canal,	Port Huron, Mich.	Sept. 12
	Advertised, Eng. News, Sept. 12 and 19.		
Oct. 1.	State capitol work,	Denver, Colo.	Sept. 12
Oct. 1.	Court house,	Knoxville, Ia.	Sept. 12
Oct. 1.	Electric light plant,	Mt. Sterling, O.	Sept. 12
	Advertised, Eng. News, Sept. 12.		
Oct. 2.	Court house,	Columbus, Ga.	Sept. 5
Oct. 2.	Pig lead (100 tons),	Buffalo, N. Y.	Sept. 19
Oct. 2.	Sewers,	Buffalo, N. Y.	Sept. 19
Oct. 3.	Bridge abutments,	Franklin, Pa.	Sept. 19
Oct. 3.	Drawbridge,	Bridgeton, N. J.	Sept. 19
Oct. 4.	Bridge superstructure,	Franklin, Pa.	Sept. 19
Oct. 4.	Water-works system,	Peotone, Ill.	Sept. 19
Oct. 4.	Macadamizing,	Stapleton, N. Y.	Sept. 19
Oct. 4.	Highway bridge,	Stapleton, N. Y.	Sept. 19
	Advertised, Eng. News, Sept. 19 and 26.		
Oct. 4.	Pipe sewers (4,800 ft.),	McKees Rocks, Pa.	Sept. 19
	Advertised, Eng. News, Sept. 19 and 26.		
Oct. 4.	Brick sewers,	McKees Rocks, Pa.	Sept. 19
	Advertised, Eng. News, Sept. 19 and 26.		
Oct. 5.	School building,	Norwood, O.	Sept. 12
Oct. 5.	Reservoir,	Oberlin, O.	Sept. 19
	Advertised, Eng. News, Sept. 19.		
Oct. 7.	Macadamizing,	Van Wert, O.	Sept. 19
Oct. 7.	Bridges (2),	Leavenworth, Kan.	Sept. 19
Oct. 7.	Iron bridge,	Brookings, S. Dak.	Sept. 19
Oct. 7.	Bridges,	New Berne, N. C.	Sept. 19
Oct. 7.	Piles (5,500), at	Fort Delaware, Del.	Sept. 19
	Advertised, Eng. News, Sept. 19 to Oct. 3.		
Oct. 8.	Water-wks system,	Grand Junction, Col.	Sept. 19
	Advertised, Eng. News, Sept. 19 to Oct. 3.		
Oct. 9.	Brick paving,	Cleveland, O.	Sept. 19
Oct. 9.	Sale of canal,	Annapolis, Md.	Aug. 22
Oct. 9.	Water-works crib,	Cleveland, O.	Sept. 12
Oct. 9.	Traveling cranes (2),	Cleveland, O.	Sept. 12
Oct. 9.	Mechanical stockers,	Cleveland, O.	Sept. 12
Oct. 10.	Pipe sewers (7,084 ft.),	Warren, O.	Sept. 19
Oct. 14.	Use of sewage and land,	Salt Lake City.	Sept. 19
Oct. 14.	Pipe sewers (15 m.),	Far Rockaway, N. Y.	Sept. 19
	Advertised, Eng. News, Sept. 19 to Oct. 10.		
Oct. 15.	Cast iron pipe,	Jacksonville, Fla.	Sept. 19
	Advertised, Eng. News, Sept. 19 to Oct. 3.		
Oct. 15.	Hydrants, etc.,	Jacksonville, Fla.	Sept. 19
	Advertised, Eng. News, Sept. 19 to Oct. 3.		
Oct. 15.	Sewer pipe,	Jacksonville, Fla.	Sept. 19
	Advertised, Eng. News, Sept. 19 to Oct. 3.		
Oct. 16.	Plans for city hall,	Somerville, Mass.	Aug. 29
Oct. 19.	Public lighting,	Knoxville, Tenn.	Sept. 19
Oct. 21.	Pumping engine,	Washington, D. C.	Sept. 12
	Advertised, Eng. News, Sept. 12.		
Oct. 26.	**Bronze tablet,**	**Gettysburg Military P'k.**	**Sept. 12**
	Advertised, Eng. News, Oct. 3.		
Nov. 1.	**Plans school building,**	**Pittsburg, Pa.**	**Aug. 8**
Nov. 19.	State capitol,	Olympia, Wash.	Sept. 12
	Advertised, Eng. News, Sept. 12 to Oct. 31.		
Dec. 2.	Sewers (22 miles),	Mobile, Ala.	Sept. 19
	Advertised, Eng. News, Aug. 29 to Oct. 24.		
No date.	Artesian wells,	Nyack, N. Y.	Sept. 19
	Advertised, Eng. News, Sept. 19.		
"	Artesian well,	Morgan Park, Ill.	Sept. 19
"	Iron bridge,	Sidney, O.	Sept. 19
"	Brick sewer,	New Brunswick, N. J.	Sept. 19
"	Sewers,	Henderson, Ky.	Sept. 19
"	Steel bridge,	Logan, Kan.	Sept. 19

RAILWAYS.

East of Chicago.

CHICAGO, UNION CITY & CINCINNATI.—This company has been reorganized, and press reports state that the construction will be resumed at once on a line from Union City, Ind., northwest to Nappanee, Elkhart county, a distance of about 80 miles. The reports state that the roadbed was graded 15 years ago from Union City to Bluffton, a distance of 30 miles, and from there the road will be graded at once. The line will be a direct one through Portland, Bluffton, Huntington, South Whitney, Warsaw, connecting with the Baltimore & Ohio, which furnishes the equipment. The officers elected last week are as follows: Pres., J. C. Fawcett, Louisville, Ky.; Secy. and Treas. George W. Patchell, Union City; directors, W. W. Wisell, Bluffton; Captain J. Ross, Union City; Dr. Reuben McFarland, New Pittsburg; J. J. M. Lafollette, Portland; W. H. Slaughter, New York; R. C. Refenbent, Cincinnati, and the officers. The directors voted $110,000 to aid the enterprise, which will be bonded to the New York Trust & Endowment Co.

CLARION.—Incorporated in Pennsylvania Sept. 10 to do a general steam railway business at Bradford, Pa.; capital stock, $110,000, with $20,000 paid in; Pres., D. H. Jack, Bradford, Pa.

FREDERIC & CHARLEVOIX.—A local paper states as follows: Grading and tracklaying on the Frederic & Charlevoix Railway, now being built by David Ward, of Detroit, to East Jordan, has reached a point about five miles south of there, and within the next few weeks East Jordan will be reached for the first time by rail.

GREENFIELD & MORRISTOWN.—A press report from Anderson, Ind. states that F. J Brownell, owner of the old Muncie dummy steam street car line, which was sent to the rear a few months ago by the introduction of electricity, closed a contract Sept. 7 to build a railway connecting Greenfield with Morristown, and taking in a half-dozen towns. The road will be 30 miles in length. The motor power will be small steam engines.

INDIANA CENTRAL.—The incorporation of this company was noted last week. F. M. Baldwin, of Marion, Ind., and H. N. Wilson, of Indianapolis, accompanied by J. E. Putnam, Scott Patton, Clarence Cooley and A. M. Turner, of Montpelier, Ind., are making surveys for the new railway, which is projected from Union City to Huntington, Ind. Gen. Man., J. Z. Armstrong, Montpelier, Ind.

LAKE TERMINAL.—Incorporated in Ohio Sept. 14 with a capital stock of $2,000,000, to operate between Lorain and Sandusky, and between Lorain and Cleveland; incorporators, Tom L. Johnson, A. J. Moxham, Daniel Coolidge, E. Y. Johnson and Andrew Squire; principal office at Lorain, O.

OIL CITY STATION.—Incorporated in Pennsylvania Sept. 12 to operate a steam railway between East branch Allegheny River, ½ mile south of Oil City, by way of Deep Hollow to Franklin, Pa.; capital stock, $90,000, with $18,000 paid in; Pres., John B. Smithman, Oil City, Pa.

SEBASTICOOK & MOOSEHEAD.—The construction of this railway, between Hartland and Harmony, Me., is reported as progressing rapidly. A new engine house will be erected in Pittsfield.

TORONTO, HAMILTON & BUFFALO.—It is reported that the contract for building the Welland branch of this road has been awarded to M. P. Chapman & Co., of Watkins, N. Y.—The first 15 miles have been sublet to Maxey, Larsen & Co. The grading is expected to be finished by October.

WHIPPANY RIVER.—This railway has just commenced to carry freight. It extends from Morristown to Whippany, N. J., four miles, with a one-mile branch, and was built to connect five pasteboard mills with the D., L. & W. at Morristown. Pres., J. E. Mellick.

Southern.

CAROLINA CENTRAL.—This North Carolina road, which is operated by the Seaboard Air Line, is to be extended from Rutherfordton, N. C., to Spartanburg, S. C., where important connections will be made.

MONONGAHELA & OHIO RIVER.—Incorporated in West Virginia Sept. 13 with a capital stock of $1,000,000 to build a steam railway between Bingamon Creek, Marion county, and the mouth of Fishing Creek, Wetzel county, W. Va.; incorporators, Hon. J. N. Camden, (Pres. West Virginia & Pittsburg and Monongahela River R. R. Cos.), H. P. Camden, Myer Newberger, H. H. Moss and Wm. Armstrong, all of Parkersburg, W. Va.

OCALA & SILVER SPRINGS.—The construction of this railway between Ocala & Silver Springs, Fla., is progressing rapidly, and the line is expected to be in operation by Jan. 1. It is stated that the cost

will be about $5,000 a mile. Herbert L. Anderson, Geo. H. McKay and N. R. Waterman are among those interested.

WAYCROSS AIR LINE.—B. A. Denmark, of Savannah, Ga., has secured a controlling interest in this railway and been elected president. It is reported that surveys are now being made for extending the road.

Northwest.

CHICAGO, BURLINGTON & QUINCY.—This company is reported as surveying for a branch line from Clarion, Ia., through Moravia and Iconium to Bloomfield, and it is thought probable that it will be continued at an early date to St. Louis.

DULUTH & NORTHWESTERN.—Incorporated in Minnesota Sept. 11 to build a railway from St. Louis Bay, at Duluth, to the Mesaba range and beyond. The preliminary survey has already been made; capital stock, $100,000; Pres., Alfred Merritt; Vice-Pres., Andrus R. Merritt; Secy. and Treas., Leonidas Merritt; Attorneys, A. A. Harris & Sons, all of Duluth, Minn.

TERRE HAUTE, SAYLOR SPRINGS & MOUNT VERNON.—The contract for constructing the Illinois section of this railway is reported to have been awarded to the McPherson Construction Co., of Boonville, Mo., and Capt. Henry McPherson, Pres., has opened an office at Saylor Springs, Ill., where he is sub-letting the work, according to press reports.

Rocky Mt. and Pacific.

COLORADO, UTAH & WYOMING.—The stockholders of this company have approved the route selected for this railway, and authorized an issue of bonds. The road will commence near Rawlins, Wyo., and will run via the four-mile placers to Craig and Steamboat Springs, Colo., and westward to Ashley, Utah. It is understood that a New York house has arranged for $2,500,000 bonds, the proceeds to be used in constructing the first division.

DENVER, LAKEWOOD & GOLDEN.—The Denver, Colo., "Times" states that a surveying party of 13 is at work on a route for the proposed extension to Louisville, 15 miles, and that the grading was to have been commenced this week with 100 teams and 200 men.

STREET AND ELECTRIC RAILWAYS.

BENNINGTON, VT.—The Bennington Electric R. R. Co. has been organized by A. B. Valentine, E. E. Larrabee, I. E. Gibson, J. A. Powers and E. L. Sibley.

READING, MASS.—The Reading & Lowell St. Ry. Co. has been incorporated to build an electric railway 10 miles long from Reading to Wilmington and Billerica; capital stock, $50,000; directors, Chas. F. Woodward, Henry H. Savage and Silas W. Flint, of Wakefield, Mass.; Chas. F. Brown, James A. Bancroft and Harley Prentiss, of Reading.

PROVIDENCE, R. I.—The New York, New Haven & Hartford R. R. Co. is considering the question of equipping its Warwick and Oakland Beach branch, about 15 miles long, with electricity.

POUGHKEEPSIE, N. Y.—It is reported that the Poughkeepsie Transportation Co. is to build the proposed New Paltz & Highland Electric Ry. B. Van Steenburgh, 53 Broadway, New York city, and Goshen, N. Y., is interested.

WHITE PLAINS, N. Y.—The New York, Elmsford & White Plains Ry. Co. has petitioned for permission to extend its electric road.

CAMDEN, N. J.—The council has passed ordinances granting the West Jersey Traction Co. permission to extend its electric road through this city for about 14 miles, and the Camden, Gloucester & Woodbury Ry. Co. permission to extend its electric road for two miles. Supt., H. M. Royal.

HOBOKEN, N. J.—The Hoboken R. R. Warehouse & Steamship Connecting Co. has been incorporated to build an electric railway; capital stock, $300,000; incorporators, Edwin A. Stevens, C. Albert Stevens, Edwin A. S. Lewis, Wm. A. Macy and Palmer Campbell.

PITTSTON, PA.—An electric railway is projected from this city to connect with the Wilkes Barre and Scranton lines. James L. Slocum, of Pittston, and John Duckworth, of Scranton, are reported as interested.

POTTSVILLE, PA.—It is stated that the Schuylkill Electric Ry. Co. has awarded to P. F. Connell contracts for building two new electric lines, one from Minersville to Taylorsville, and the other from Pottsville to Schuylkill Haven, a total distance of 12 miles. W. W. Hess, Pres. Philadelphia Construction Co.

BALTIMORE, MD.—It is stated that specifications are being prepared for the proposed Washington, Sandy Hill & Baltimore Electric Ry., surveys for which have been completed, as noted in our issue of last week. Bids will soon be asked for constructing the line, which is estimated to cost $25,000 a mile. Gen. Man., Frank C. Drane.

BOWLING GREEN, KY.—M. H. Crump, Gen. Man., writes us that the Park City Ry. Co. will have its electric road now being built from Bowling Green to Delafield, on the Banan River, a distance of 4½ miles, completed by Sept. 25. Pres., J. B. Wilford.

LOUISVILLE, KY.—The Louisville, Mount Washington & Fairfield Electric R. R. Co. has been organized. Surveys for the proposed railway will be begun as soon as 20% of the capital stock has been subscribed. Directors, Lafayette De Witt, James McKenna and J. C. Wright, of Louisville; J. M. Lilly, of Fairfield; W. H. Ellab, of Mount Washington, and S. Lloyd, of High Grove, Nelson county.

TOLEDO, O.—The Toledo & Petersburg Electric Ry. Co. has been incorporated to build a road about 18 miles long; capital stock, $200,000; O. S. Bond, W. S. Coon, and J. J. Simmons, of Toledo, O.; Willis Baldwin, of Monroe, and John O. Zabel, of Petersburg, are interested.

URBANA, O.—W. H. Hanford & Co. have been granted a franchise for an electric railway through this city, which it is proposed to extend to Springfield and Dayton, work on which will be commenced at once.—E. Hunter Moore and others have been granted a franchise for the Urbana, Mechanicsburg & Columbus St. Ry. through this city.

SAGINAW, MICH.—The Inter-Urban Ry. Co. has awarded the contract for furnishing steel rails to the Illinois Steel Co., of Chicago, at about $20,000. John S. Porter, of Saginaw, has been awarded the contract for the ties, and that for the poles has been awarded to Wm. F. Stevens. Bids were opened Sept. 16 for constructing the road.

BELVIDERE, ILL.—The Belvidere City Ry. Co. has been incorporated to build an electric road; capital stock, $35,000; incorporators, John M. Roach, Jas. B. Canterbury, Charles E. Fuller.

CHICAGO, ILL.—The Central Elevated Ry. Co. is securing the right of way for an elevated road. The company has a capital stock of $7,500,000. Pres., Robert Shepard; Vice-Pres., S. D. Kimbark; Treas., Z. S. Holbrook; Secy., E. Hamilton Hunt. These men are all members of the Wabash Ave. Property Owners' Protective Association.

DULUTH, MINN.—The Duluth St. Ry. Co. has decided to extend its West Third St. electric road to Ironton. Gen. Man. and Supt., H. Warren; Ch. Engr., M. Noble; Electricians, L. E. Fairchild and T. Armstrong.

ST. JOSEPH, MO.—The St. Joseph Traction & Lighting Co. has sold its property and the company will be reorganized with an increased capital stock. The electric railway will be improved and extended, for which $500,000 in bonds will be issued. Gen. Supt., W. T. Van Brunt.

ST. LOUIS, MO.—A survey is being made for an electric railway from Rinkleville to Ferguson, a distance of 10 miles. It is stated that the St. Louis County Ry. Co. is probably interested.

ELECTRIC LIGHT AND POWER.

SPRINGFIELD, MASS.—The Springfield United Electric Co. has petitioned the state authorities for permission to issue $200,000 in bonds, part of which is for the construction of a new power station at Indian Orchard, near Springfield.

ELLIS ISLAND, N. Y. H.—Bids are asked until Sept. 24 for furnishing and laying a terra cotta sectional conduit, removable electric light cables, and for the general repair of the electric light wires which are located in the Ellis Island building. Dr. J. H. Senner, Comr. Immigration, Ellis Island.

HOMESTEAD, PA.—Bids are asked until Sept. 28 for lighting the streets with 60 or more 2,000-c.p. arc lights for 10 years, as stated in our advertising columns. S. B. Depuey, Borough Clk.; O. S. Swisher, Chn. Com.

PHILADELPHIA, PA.—Bids are asked until Sept. 24 for furnishing a new armature and commutator for an incandescent dynamo for the county prison at 10th and Reed Sts. Howard Perkins, Supt. Prison.

BALTIMORE, MD.—Owens & Bieler have completed plans for a boiler house 80 × 45 ft., and a power station 50 × 35 ft., for the Chesapeake Electric & Water Co., both of which are estimated to cost about $15,000.

ROANOKE, VA.—The council is considering estimates for constructing an electric light plant. W. E. Thomas, Cy. Clk.

DUBLIN, GA.—Bids will soon be asked for constructing an electric light plant, with a capacity of 100 arc and about 3,000 incandescent lights. Jas. B. Sanders, Mayor.

SHREVEPORT, LA.—The citizens are about to petition the council to erect a municipal electric light plant.

KNOXVILLE, TENN.—Bids are asked by the board of public works until Oct. 19 for furnishing 200 arc and about 1,000 gas lights for 10 years.

BRONSON, MICH.—An election is to be held Sept. 23 to vote on the question of lighting the streets by electricity, for which a company will erect an electric light plant. W. M. Shepard, Village Clk.

GARRETT, IND.—Bids are asked until Sept. 26 for constructing an electric light plant, as described in our advertising columns. Engr., G. L. McKibben, City Hall, Van Wert, O.; W. J. Martin, Cy. Clk.

GREAT BEND, IND.—Roosa & Galloway are contemplating the erection of an electric light plant. W. T. Estabrook, Cy. Clk.

ROCKFORD, ILL.—The plans and specifications for an electric light plant, prepared by Frank B. Rae, Fort Dearborn Bldg., Chicago, have been accepted by the council. Definite action on the matter has been temporarily delayed.

KENOSHA, WIS.—The Stirling Cycle Co. has engaged Frank B. Rae, Elec. Engr., Fort Dearborn Bldg., Chicago, to design and install a complete lighting plant, including 600 incandescent and 25 arc lights. A new engine and dynamo will be purchased.

DULUTH, MINN.—The Minnesota Canal & Power Co. is making arrangements to soon begin the construction of a proposed canal for transmitting power to this city. Pres., F. J. Hanchett; Vice-Pres., H. H. Hanford; Secy. and Treas., O. H. Simmonds.

FERGUS FALLS, MINN.—The city voted Sept. 7 to issue $25,000 in bonds for building an electric light plant.

RUSH CITY, MINN.—A. J. Stowe, W. Wadlow and C. F. Jackson have been granted a 30-year franchise for an electric light plant.

VAN BUREN, ARK.—H. J. Isbel, of Parsons, Kan., has been granted a 15-year franchise for an electric light plant.

GRAND ISLAND, NEB.—Bids are asked until Sept. 27 for constructing an electric light plant for the Soldiers' & Sailors' Home at Grand Island. M. C. Russell, Chn. Bd. Lands and Public Bldgs.

NEW COMPANIES.—Morristown Electric Light Co., Morristown, Tenn.; John K. Shields, R. E. L. Mountcastle, George A. Crouch, W. H. Paine, Jr.

People's Electric Co., Madison, Wis.; $10,000; L. E. Kerns, F. H. Ford, L. W. Kroncke.

Citizens' Electric Co., Williamsport, Pa.; $2,000; Treas., Grant Sweet, Williamsport, Pa.

Joliet Light, Heat & Power Co., Joliet, Ill.; $100,000; J. E. Sutherland, J. L. Highland, J. S. Ward.

Punta Gorda Ice & Power Co., Punta Gorda, Fla.; $10,000; J. H. Farrington, Wm. S. Stetson, Lorenzo T. Blacksom.

Citizens' Electric Co., Mishawaka, Ind.; $25,000; to supply electric light and power over five miles of circuit; Pres., J. A. Roper; Treas., M. V. Buger.

New Britain Electric Construction Supply Co., New Britain, Conn.; $5,000, with $1,000 paid in; H. C. Williams, G. W. Fisk and Harry Horn, New Britain.

Grier-Young Electric Co., Camden, N. J.; $10,000, with $2,000 paid in; to carry on a general electric business; Alfred S. Hattle, Henry G. Grier, Mahlon D. Young, Philadelphia, Pa.; Aaron T. Lovett, Camden, N. J.

Electric Gold Extraction Co., Council Bluffs, Ia.; $1,000,000; to extract gold from ore and quartz by the use of electricity; Robert McKnight, G. M. Taylor, J. R. McKinney.

Louis McCarty Insulating Co., Saco, Me.; $200,000, with $2,000 paid in; to manufacture insulators for electrical purposes; Pres., Thomas Allen; Treas., Louis McCarty, Boston, Mass.

Nambe Power & Improvement Co., Santa Fe, N. Mex.; to transmit 400 HP., at an estimated cost of $30,000, from the Nambe Falls, about 25 miles from Santa Fe; L. A. Hughes, T. J. Helm, J. W. Akers, M. G. Reynolds.

BRIDGES.

WESTBROOK, ME.—The Maine Central R. R. Co. is reported as about to build a double-track steel bridge of 200 ft. span over the Presumpscot River, and also a 50-ft. bridge over a street.

TAUNTON, MASS.—The following bids were received Sept. 4 by Luther Dean, Cy. Engr., for constructing a girder bridge, as advertised in Engineering News; John H. Church, Supt. Sts.:

R. F. Hawkins Iron Works, Springfield, Mass..	$4,225
Dean & Westbrook, New York, N. Y.	4,290
King Bridge Co., Cleveland, O.	4,398
J. E. Buddington, New Haven, Conn.	4,410
Boston Bridge Co., Boston, Mass.	4,459
Canton Bridge Co., Canton, O.	4,485
Berlin Iron Bridge Co., East Berlin, Conn.	4,605
Toledo Bridge Co., Toledo, O.	4,691
Massillon Bridge Co., Massillon, O.	4,789
New Columbus Bridge Co., Columbus, O.	4,800

The contract has not yet been awarded. J. A. Dailey & Son, of Providence, R. I., were awarded the contract for stonework at $7 per cu. yd. for the rough stone, and $10 per cu. yd. for the finished stone.

ALBANY, N. Y.—The charter and franchise of the Green Island Bridge Co. have been transferred to the Delaware & Hudson Canal Co. It was incorporated about two years ago to build a new iron bridge across the Hudson River above Troy, to Green Island and Cohoes, to enable the Troy City Ry. to make a new connection with these places. Pres., Horace G. Young; Secy. and Treas., A. Kemper; directors, Horace G. Young, A. Kemper, C. D. Hammond, R. C. Plackall, J. W. Burdick, R. W. Carr, J. A. Knickerbocker and John Knickerbocker.

AMSTERDAM, N. Y.—It is reported that Maj. A. V. Morris has offered to donate $5,000 to aid in the construction of a bridge over the river, canal and railroads in the east end of the city, estimated to cost $30,000.

JOHNSTOWN, N. Y.—It is proposed to construct two steel bridges of 90 and 120 ft. span. W. S. Franklin, Cy. Engr.

STAPLETON, N. Y.— Bids are asked until Oct. 4 for constructing a masonry, steel and brick highway bridge over the Harbor Brook at Henderson Ave., in Castleton, Richmond county, as stated in our advertising columns. Engr., Henry P. Morrison; Franklin C. Vitt, Clk. Bd. Supervisors.

BRIDGETON, N. J.—Bids are asked until Oct. 3 for constructing a drawbridge over the Cohansey River at Broad St. Joseph T. White, A. Harrs, William Leach, Committee.

PERTH AMBOY, N. J.—C. C. Hommann has submitted plans to the board of freeholders for the proposed Perth-South Amboy bridge, estimated to cost about $146,000.

RIDGEWOOD, N. J.—Bids are asked until Sept. 28 for constructing a Melan arch bridge over Saddle River. Bids for this work were received Sept. 9, but were all rejected. T. V. Terhune, Chn. Com. Freeholders.

EASTON, PA.—The following bids were received Sept. 13 for rebuilding two steel bridges. Engr., J. M. Porter, Easton; M. H. Schall, Clk. County Comr.:

Bidders	Snyder's bridge	Kutz bridge	Both bridges
Variety Iron Works Co., Cleveland..	$4,399	$1,020	$5,419
Nelson & Buchanan, Chambersb'g, Pa.	*4,034	1,056	4,946
Owego Bridge Co., Owego, N. Y.	3,789	1,160	4,849
Wrought Iron Bridge Co., New York	3,875	1,250	5,100
Groton Bridge Co., Groton, N. Y.	4,200	1,300	5,500
Berlin Iron B'dge Co., East Berlin.	4,200	1,218	5,400
Detroit Bridge Wks., Detroit, Mich.	5,958	1,659	7,617

* Awarded contract.

FRANKLIN, PA.—Bids are asked until Oct. 3 for building stone abutments for a bridge over Richey Run, Richland township, and for one over Sugar Creek, Cherrytree township, and until Oct. 4 for building the superstructure for an iron bridge 50 ft. long over Sugar Creek, Cherrytree township. T. B. La Rue, County Comr.; E. K. Smiley, Clk. Comrs., Franklin.

ROCHESTER, PA.—It is stated that W. O. Jutte, of Jutte, Foley & Co., of Pittsburg; S. P. White of New Brighton, and Augustus Jutte, are interested in the projected bridge over the Ohio River at this place, which was noted in our issue of last week.

SHARPSVILLE, PA.—It is reported that the Mahoning division of the Erie system is to have two new steel bridges. One of these will be built at Cleveland at a cost of $8,000, and the other will span the Shenango River, near Sharpsville. The latter structure will cost $22,000, and will be 300 ft. in length.

NEW BERNE, N. C.—Bids are asked by the commissioners of Craven county until Oct. 7 for building wooden bridges with iron draws. James W. Biddle, Register, New Berne.

MOBILE, ALA.—The board of road commissioners has voted to ask for bids for constructing three iron bridges in Mobile county.

MARYSVILLE, O.—Bids are asked by the Board of county commissioners until Sept. 23 for constructing an 84-ft. iron bridge. Samuel A. Hudson, Audr.

SIDNEY, O.—Bids are asked by the commissioners of Shelby county for constructing an iron bridge over Laramie Creek at Newport. The structure will be 114

ft. long, with a roadway 16 ft. wide. J. S. Laughlin, County Audr.

ZANESVILLE, O.—The following bids have been received for building a steel drawbridge 148 ft. long at the west end of the county bridge at Taylorsville; G. E. Zimmer, Audr., Muskingum county:

T. B. Townsend Bridge & Cons. Co. Zanesville	$6,458
Wisconsin Bridge & Iron Co., Milwaukee, Wis.	4,206
Toledo Bridge Co., Toledo, O.	4,140
Iron Substructure Co., Columbus, O.	3,800
New Columbus Bridge Co., Columbus O.	6,489
King Bridge Co., Cleveland.	$4,304, $4,368, $4,520, 4,650
Penn Bridge Co., Beaver Falls, Pa.	4,750
Wrought Iron Bridge Co., Canton, O.	$10,000, 8,028
Youngstown Bridge Co., Youngstown, O.	$4,503, 4,858
Variety Iron Works, Cleveland, O.	5,459
Nelson & Buchanan, Chambersburg, Pa.	6,324
Frank C. Lewis.	5,000
Massillon Bridge Co., Massillon, O.	3,800

LAFAYETTE, IND.—The construction of a viaduct at 18th St., to be of three spans of 60 ft. each, is proposed. W. K. Eldridge, Cy. Engr.

SAGINAW, MICH.—It is reported that the Inter-Urban Ry. Co. has asked for bids for constructing a bridge over the Saginaw River.

LACON, ILL.—The construction of a steel bridge 900 ft. long over the Illinois River is projected. J. R. Chapman, Supt. Water-Works.

LA SALLE, ILL.—Arrangements are being made for constructing a 200-ft. span highway bridge over Big Vermillion River. C. H. Nicolet, Cy. Engr.

MARINETTE, WIS.—Bids are asked until Oct. 1 for constructing the substructure for the Wisconsin half of the bridge over the Menominee River at Menominee, Mich. This portion of the bridge will contain 1,100 cu. yds. of masonry. The superstructure will probably be awarded about Jan. 1. The bridge will consist of seven 100-ft. spans, with a 24-ft. roadway and a 7-ft walk. E. L. Shaw, Cy. Engr., Marinette.

DULUTH, MINN.—The council has passed an ordinance authorizing the committee to make arrangements for the construction of a steel viaduct over the railway tracks at Garfield Ave. The structure will be 1,860 ft. long, and is estimated to cost $150,000, as noted in our issue of last week. E. F. Mitchell and A. M. Cox, Committee.

BROOKINGS, S. DAK.—Bids are asked until Oct. 7 for building two wooden or iron bridges. J. T. Nelson, County Audr.

CARTHAGE, MO.—Bids are asked until Sept. 27 for rebuilding an iron bridge over Buck Branch. Address Geo. H. Bradford.

KANSAS CITY, KAN.—H. H. Filley, Cy. Engr., has completed specifications for the proposed viaduct at Allen Ave. and 23d St., estimated to cost $32,000.

LOGAN, KAN.—Bids are asked by the county clerk for constructing a 140-span steel bridge over the Solomon River. Address I. D. Thornton, Phillipsburg, Kan.

LEAVENWORTH, KAN.—Bids are asked until Oct. 7 for building a bridge over Fall Creek in Alexandria township, and one over Wolf Creek, in Fairmount township. J. W. Niehaus, County Clk.

BUILDINGS.

BOSTON, MASS.—Bids are asked until Sept. 23 for erecting a ladder house for the fire department. H. S. Russell, Fire Comr.

ROXBURY, MASS.—John Lyman Faxon has prepared plans for a five-story brick and iron office building, 125 × 56 ft., at 2200 Washington St., for Frank Ferdinand, to cost $85,000.

NEWPORT, R. I.—Bids are asked until Sept. 30 for constructing commandant's quarters and hospital at the United States naval station on Coasters' Harbor Island. F. M. Ramsey, Ch. Bureau Navigation, Washington, D. C.

BROOKLYN, N. Y.—Bids are asked until Sept. 26 for making alterations and additions to the elevator plant, etc., of the court house and post office building, as stated in our advertising columns. J. B. Clark, Acting Supervising Arch., Washington, D. C.——Ground was broken Sept. 14 for the new Brooklyn Museum of Art and Sciences, on Prospect Hill, which is estimated to cost $3,000,000. Only one wing of the building will be erected at first, which will cost $254,000. The contract calls for the completion of this wing by January, 1897. Archs., McKim, Mead & White, New York; Frank Squier, Comr. Pub. Parks.——The grain warehouse at the foot of Quay St., belonging to Marsh, White & Co., was destroyed by fire Sept. 15, at a loss of $100,000. The building was 200 × 200 ft.

BUFFALO, N. Y.—The plans of F. C. Calkins have been accepted for a 16-room school building at Delavan Ave. and Moselle St. The board of public works will now ask for bids for the construction. It is to be three stories high, of brick and stone, and will cost $45,000.

DUNKIRK, N. Y.—The board of education has directed the committee to advertise for bids for constructing a three-story school building, 132 × 80 ft., as an addition to the academy building, estimated to cost $40,000. Arch., W. H. Archer, 85 West Eagle St., Buffalo, N. Y.

NEWBURGH, N. Y.—Bids are asked until Sept. 26 for constructing the foundations for the post office building. H. R. P. Hamilton, Acting Supervising Arch.

NEW YORK, N. Y.—Plans have been filed by the city for a new station house and prison for the Ninth police precinct, at 133 to 137 Charles St., to cost $95,000; by F. M. Rupton, 106 Reade St., for an eight-story brick manufactory and workshops at 23 to 27 Reade St., to cost $90,000.

LONG BRANCH, N. J.—The Hotel Co. of West End is making arrangements to build a new hotel to take the place of the present West End Hotel. The building will be five stories high, 860 ft. long, and will contain 460 guests' chambers.

SCRANTON, PA.—Bids are asked until Sept. 23 for erecting a 12-room school building on Chestnut St. E. D. Fellows, Secy. Bd. Control.

BALTIMORE, MD.—Bids are asked until Sept. 30 for constructing the Cedar Point Light Station, Md. Capt. Eric Bergland, U. S. Engr., Baltimore.

ATLANTA, GA.—The commissioners of Fulton county are about to engage an architect to prepare plans for a new county jail, estimated to cost about $100,000.

CLEVELAND, O.—Plans are being considered by the Historical Society trustees for the erection of a new building in the east end. Henry A. Griffin, Secy. State Bd. Trade, Secy. Com.

DETROIT, MICH.—Plans are asked until Sept. 23 for a new county building, estimated to cost $1,500,000. Henry M. Reynolds, County Clk., City Hall.

CHICAGO, ILL.—Thos. A. Davies has been granted a building permit for a 12-story brick office building at 352 to 356 Dearborn St., to cost $250,000.——Cudell & Herz have prepared plans for remodeling the building at 104 and 106 Madison St. for the Tosetti Co., estimated to cost $50,000.——George D. Milligan is about to begin work on the construction of a residence in Drexel Ave. 80 × 40 ft., and is estimated to cost $100,000

DE KALB, ILL.—Press reports state as follows: Plans have been prepared by C. E. Brush, of Chicago, and accepted by the trustees for the northern Illinois state normal school, to be erected at De Kalb, Ill. The institution will comprise several buildings, two to six stories high, with a total frontage of 350 ft. and an average depth of 60 ft., and two wings extending back 100 ft., besides assembly hall, with stage and gymnasium, 80 × 85 ft., and is estimated to cost $180,000. Each structure is to be built of brick, faced with Bedford stone, with interior of steel and iron construction, have slate and composition roofs, hardwood finish, steam heating and electric light plants, fireproofing and the latest improvements.

SUPERIOR, WIS.—Bids are asked by the state board of normal school regents until Sept. 25 for constructing a school building in this city. Arch., H. W. Jones, Minneapolis, Minn.; Frank H. Nutton, Landscape Arch.; address Frank Ostrander, Superior.

PORTLAND, ORE.—The following bids were received Aug. 29 by Maj. Jas. C. Post, U. S. Engr., for constructing a fog signal building, tower, etc., at Cape Arego Light Station, Ore.:

Robert Smith, Portland (awarded contract)	$11,493
Nichols & Crothers, Tacoma, Wash.	12,390
Frank Eddings, Vancouver, Wash.	13,387
C. P. Wakeman, Port Townsend, Wash.	13,975
J. D. Wickloff, Portland.	14,400
Patterson, Siglen & Lackstrom, Mansfield, Ore.	14,994
Smyth & Perkam, Portland	15,498
Thos. Wilson, Portland.	15,649
Tower & Hausen, Empire City, Ore.	18,398
Anderson & Bingham, Portland.	18,548
I. J. Campbell, Portland	18,900
Hausen & Landin, Portland.	18,989
Edward Ryan, Portland.	22,300

MONTREAL, QUE.—Bids are asked until Sept. 24 for constructing a new roof for the drill shed at Craig St. Capt. A. Benoit, Secy. Dept. Militia and Defence, Ottawa, Ont.

KINGSTON, ONT.—A heavy wind on Sept. 12 damaged the car shops and wrecked the cotton mill in this city, making a loss of $128,000.

WATER-WORKS.

YORK, ME.—Dennett & Jose, civil engineers, of Saco, Me., are making surveys for the York Shore Water Co.'s system, which will be over six miles in length.

MONTGOMERY CENTRE, VT.—A correspondent writes us that H. O. Rowley and Chas. T. Hall are the sole proprietors of the new works at this place. The mains are 8 to 4 ins. in diameter; supply from a stream nearly a mile distant and at an elevation of 175 ft. above the village. The plant cost about $3,000. The service will not be extended to Montgomery, about two miles distant, at present.

NORTH ADAMS, MASS.—Prof. E. P. Harris, of Amherst College, has analyzed samples of the water supply and finds that from the Ashland St. artesian well unfit for use.

WINCHENDON, MASS.—The North Central Aqueduct Co. has been organized: Pres., N. C. Matthews; Treas., H. W. Clark; Secy., E. S. Tucker.

WOONSOCKET, R. I.—The citizens are talking of putting in a filter plant at a cost of $25,000.

AKRON, N. Y.—Press reports state that the residents of this town are thinking seriously of putting in works.

ALBANY, N. Y.—Surveys are now being made for a new 100,000,000-gallon reservoir, which will be 350 ft. above tide water, and from 70 to 80 ft. higher than any part of the city now built on.

BUFFALO, N. Y.—Bids are asked until Oct. 2 for 100 tons of pig lead. R. G. Parsons, Secy. Dept. Pub. Wks.

CANASERAGA, N. Y.—A. T. Peabody, Secy., writes us that the contract for constructing works, as advertised in Engineering News, has been awarded to Geo. P. Rhen & Co. at $11,787. There were 13 bids on pipe, hydrants, etc., and the following bids received for the complete plant:

Geo. P. Rhen & Co., Hornellsville, N. Y.	$12,037
M. B. Birdseye, Syracuse, N. Y.	11,741
O'Connor & Co., Syracuse, N. Y.	11,845
A. F. Nims, Philadelphia, N. Y.	11,879
F. G. Babcock & Co., Hornellsville, N. Y.	16,072

FORT EDWARD, N. Y.—F. B. Davis, Secy. Comrs., informs us that the following bids were received for laying water pipe across the river at this place: John Marsden, Utica, N. Y., $5,900; Sanford & Stillman, Jersey City, N. J., $10,950; J. C. Stroh, Wilkes Barre, Pa., $6,500; O. M. Weand, Reading, Pa., $8,500.

LAURENS, N. Y.—Bids are asked until Oct. 1 for construction works, as stated in our advertising columns. Engr., E. F. Musson, Norwich, N. Y.; D. S. Peet, Secy. Comrs.

LITTLE FALLS, N. Y.—The board of public works is reported as contemplating the construction of a new storage reservoir. H. W. Warren, Cy. Clk.

MONTOUR, N. Y.—This town is said to be in favor of a system of water-works.

NEWTOWN, N. Y.—The Citizen's Water Supply Co. of this place has increased its capital stock from $100,000 to $150,000.

NYACK, N. Y.—Bids are asked for sinking artesian wells, as stated in our advertising columns. Jas. S. Haring, Engr.; A. E. Christie, Secy. Comrs.

PERRY, N. Y.—The following bids were received Sept. 10 for constructing works, as advertised in Engineering News. Engr., J. F. Witmer, Buffalo:

Pipe and Special Castings.

Chattanooga Fdry. & Pipe Co., Chattanooga.	$15,271.55
So. Pittsburg Pipe Wks., So. Pittsburg, Tenn.	17,100.00
Chas. Millar & Son, Utica, N. Y.	17,598.80
Warren Foundry & Mach. Co., New York.	16,949.60
F. B. Hawkins & Co., New York.	16,922.25
R. D. Wood & Co., Philadelphia.	17,743.95
Addyston Pipe & Steel Co., Cincinnati, O.	16,996.95
McNeal Pipe & Foundry Co., Burlington, N. J.	16,810.20

Hydrants, Valves and Boxes.

Kennedy Valve Co., New York.	$2,908.45
R. D. Wood & Co., Philadelphia, Pa.	3,100.00
Crane Co., Chicago, Ill.	2,875.00
Mich. Brass & Iron Works, Detroit, Mich.	3,000.00
F. B. Hawkins & Co., New York.	3,331.00
Eddy Valve Co., Waterford, N. Y.	2,921.30
Ludlow Valve Co., Troy, N. Y.	3,294.90
Rensselaer Valve Mfg. Co., Troy, N. Y.	1,213.00
Ross Valve Co., Troy, N. Y.	850.00

Pumps.

F. R. Dravo & Co., Pittsburg, Pa.	$7,750
J. H. McGowen & Co.,[1] Cincinnati, O.	3,050
Snow Steam Pump Co., Buffalo, N. Y.	2,300
H. R. Worthington, New York.	2,400
Buffalo Steam Pump Co., Buffalo, N. Y.	2,495
Dean Steam Pump Co., Holyoke, Mass.	2,615

Pipelaying.

M. B. Birdeye, Fayetteville, N. Y.	$9,174.12
O'Conner & Co., Syracuse, N. Y.	8,460.52
W. B. Wilson,[2] Buffalo, N. Y.	7,114.00
A. F. Nims,[3] Philadelphia, N. Y.	9,156.12
W. S. Wagner, Minneapolis, Minn.	8,000.00
Speyer & White, Buffalo, N. Y.	8,465.68
Chandley Bros. & Co.,[4] Beaver Falls, Pa.	8,020.64
Coon & Mooney & Co., Wilkes Barre, Pa.	8,472.88
C. D. Chisholm, Canandaigua, N. Y.	9,883.92
W. H. Cookman, Niagara Falls, N. Y.	9,124.96
Tippett & Wood, of Phillipsburg, N. J., bid $3,368 for a stand-pipe, without foundation.	

[1] Boilers, $1,850. [2] Building, $4,913.30. [3] Building, $7,169.70. [4] Building, $5,037, and stand-pipe, $4,590.

PHILADELPHIA, N. Y.—A. F. Nims has made surveys for a gravity supply from a spring about five miles distant. The complete plant is estimated to cost about $27,000. It is probable that the question will soon be submitted to a vote of the people.

RIPLEY, N. Y.—Bids are asked until Sept. 27 for furnishing materials and constructing works, as stated in our advertising columns. F. N. Randall, Secy. Ripley Water Supply Co.

SYRACUSE, N. Y.—Bids are asked until Sept. 30 for the purchase of $300,000 of 3½% water bonds. E. F. Allen, Cy. Treas.

WINDHAM, N. Y.—The Windham Village Water Co. has been incorporated, with a capital stock of $10,000; directors Chas. L. Andrus and Geo. W. Kendall, of Stamford; Josiah C. Tallmadge, of Windham; Frank M. Andrus, Richard B. Robinson and Daniel D. Andrus, of Roxbury.

WHITESBORO, N. Y.—Surveys have been made for water-works. P. A. Hale is Town Clerk.

ALLAIRE, N. J.—The Allaire Water Supply & Land Co. has been incorporated, with a capital stock of $150,000, with $76,800 paid in, to operate at this place and Lakewood, N. J.; incorporators: Hal Allaire, Allaire, N. J.; Wm. J. Harrison, Lakewood, N. J.; Oliver H. Brown, Spring Lake, N. J.; Geo. P. Olcott, East Orange, N. J.; James P. Garrison, Lower Squankum, N. J.

ELIZABETH, PA.—The council has voted unanimously to accept a proposition of the Elizabeth Water Co. to construct works. The construction will be commenced as soon as possible.

HAZLETON, PA.—The Lehigh Water Co. is being organized with a capital stock of $1,500,000 to build dams and to supply water in the Middle Coal Fields, according to the Hazleton "Sentinel."

MAHANOY CITY, PA.—There is talk of building a reservoir of 75,000,000 to 100,000,000 gallons capacity at this place. E. Stillman, Supt. Water-Works.

MALVERN, PA.—Press reports state that 122 citizens have petitioned the council to erect municipal works at a cost of $9,000, and that the council is a tie on the question. A company is now laying mains in this place.

PHILADELPHIA, PA.—Bids will probably be asked in a few days for the completion of the Queen Lane reservoir.

SOUTH BETHLEHEM, PA.—Chas. H. Neisser, Supt., is quoted as stating that the South Bethlehem Gas & Water Co. will rebuild its low-service reservoir and lay about two miles of 20-in. pipe, and make other improvements to the works. Consult. Engr., J. Marshall Young, Easton, Pa.

PRINCESS ANNE, MD.—Plans and specifications for works are being made; estimated cost, $5,000 to $6,000.

CHESTER, S. C.—The citizens are agitating the question of water-works.

JACKSONVILLE, FLA.—Bids are asked until Oct. 15 for furnishing 163,000 ft. of 20 to 4-in. pipe, 350 hydrants, 210 valves, etc., as stated in our advertising columns. R. N. Ellis, Supt.; B. F. Dillon, Chn. Com.

BIRMINGHAM, ALA.—The "Age-Herald" states that there is a probability that this city will have three systems of water-works within the next year or two. Caldwell Bradshaw and others have had before the council for some time a plan for the construction of works with a supply from artesian wells at Gate City, and it is probable that the council will grant a franchise. Robert Jemison is interested in another company that wants to construct works, with a supply from East Lake.

CANTON, MISS.—B. Maas, Cy. Clk. Pro Tem., writes us that the contract for constructing works has been awarded to the Southern Electrical Mfg. & Supply Co., of New Orleans.

JACKSON, MISS.—The council has voted to annul its contract with the water company and to sue the company for $10,000 damages for failure to comply with the contract.

HUMBOLDT, TENN.—G. C. Anderson & Co., of Jackson, Tenn., have been awarded the contract for constructing works at this place.

MURRAY, KY.—The residents of this place are reported as wanting water-works.

CARROLLTON, O.—The council has awarded the following contracts: John Byder, Carrollton, brick pumping station and stack, $2,500; H. R. Worthington & Co., New York, pumping station machinery and boilers, $3,550; McQuern & Co., Canton, plant, with above exceptions, $17,000.

CLEVELAND, O.—A new 20,000,000-gallon pumping engine will be purchased at once for the Division St. station.

COLUMBUS, O.—The committee has recommended that a consulting engineer be engaged, to assist in making surveys and estimates for the new water supply.

DELPHOS, O.—This city will build works as soon as plans can be completed. Consult. Engr., R. H. Gamble, Lima, O.

JACKSON, O.—The question of a water supply is again being agitated.

MANSFIELD, O.—The citizens have voted to issue $20,000 in bonds for extensions.

NORWOOD, O.—Bids are asked until Sept. 26 for building an extension to the pumping station. Consult. Engr., Thos. G. Smith, Hammond Bldg., Cincinnati; Henry Rickhoff, Chn. Bd.

OBERLIN, O.—Bids are asked until Oct. 5 for constructing a storage reservoir, as stated in our advertising columns. W. B. Gerrish, Supt. and Cy. Engr.

WAUSEON, O.—The citizens have voted in favor of constructing works.

YOUNGSTOWN, O.—The following contracts have been awarded for materials, as advertised in Engineering News: Lake Shore Foundry, pipe; R. D. Wood & Co., hydrants; Rensselaer Mfg. Co., valves; Raymond Lead Co., of Chicago, lead.

GARRETT, IND.—Bids are asked until Sept. 26 for constructing works, as described in our advertising columns. Engr., G. L. McKibben, City Hall, Van Wert, O.; W. J. Martin, Cy. Clk.

KENTLAND, IND.—Bids are asked until Sept. 21 for the purchase of $6,000 in water bonds, and until Sept. 27 for the construction of works. Chas. M. Davis, Town Clk.

LA PORTE, IND.—The "Herald" states that $12,000 has been appropriated for a new 5,000,000-gallon pumping engine, which will be purchased at once. F. R. Carson, Mayor.

CORUNNA, MICH.—An election will be held Sept. 21 to vote on an issue of $30,000 in bonds for water-works.

TRENTON, MICH.—The village council is reported as in favor of granting a franchise to a Detroit syndicate, which has offered to construct works.

ASSUMPTION, ILL.—The council has decided to submit the question of water-works to a vote of the people. James Padgett, St. Comr.

ASTORIA, ILL.—It is reported that plans are being made for works, and that an election will probably be held this month to vote on the question of construction.

GREENUP, ILL.—The village board is reported as in favor of constructing works in this village.

CHICAGO, ILL.—Local papers state that contracts for the northwest land tunnel have been awarded as follows: Joseph Duffy, sections 1 and 2, at $121,450 and $254,385 respectively; Weir, McKechney & Co., section 3, at $350,000. The bids were published Sept. 5.

DANVILLE, ILL.—H. C. Patterson and J. B. Chambers are members of a committee appointed to devise a method for the construction of new works at this place.

GENEVA, ILL.—D. J. Hogan is a member of a committee appointed to urge the council to take steps for the construction of works, estimated to cost $35,000.

ATWOOD, ILL.—It is reported that this place will soon have water-works.

JOLIET, ILL.—It is reported that the clerk has been directed to advertise for bids for sinking an artesian well 1,750 ft. deep.——Thomas T. Johnson and C. L. Harrison, Engrs., have submitted a proposition to the council for the construction of a water system for $200,000.

LOCKPORT, ILL.—Contracts have been awarded as follows: J. P. Miller & Co., for sinking an artesian well; Michigan Brass & Iron Co., for main pipe line and hydrants; Campbell & Dennis, of Joliet, for the pumping plant.

LA GRANGE, ILL.—Bids are asked until Sept. 20 for constructing a system, to include about 16,000 ft. of 8 to 4-in. cast iron pipe, 37 hydrants, 360 valves and boxes, etc. Engrs., Ewing & Waite, La Grange. W. T. Krausch, Village Clk.

LA GRANGE, ILL.—The following bids were received Sept. 5 for furnishing and laying 15,000 ft. of 8 to 4-in. cast iron water pipe, with valves, etc., and 400 hose services; W. B. Ewing, Engr.: Hallet & Anderson, Aurora, Ill., $12,851, with lead service, or $12,073 with iron service; James Murphy, Chicago, $15,111, or $14,786; Burns & Esson, Chicago, $15,326, or $15,308; C. & T. Iglehart, Morgan Park, Ill., $14,193, or $13,448; John L. Hodgkins, Chicago, $14,765, with lead service.

MORGAN PARK, ILL.—Bids are asked by Edgar Ayres, Village Clk., for sinking an 8 or 10-in. artesian well 1,200 ft. deep.

PEOTONE, ILL.—Bids are asked until Oct. 4 for constructing works. Geo. Rehkopf, Village Clk., writes us that the following bids were received last week for this work, but were rejected for legal reasons: Challenge Wind Mill & Feed Mill Co., Batavia, $6,787; Gafany & Long, 140 Dearborn St., Chicago, $6,200 or $6,848, modified; Casgrain & McDonald, Chicago, $7,595; J. R. Blatchford, Kankakee, Ill., $8,125; Reidlaw & Water, Ottawa, Ill., $8,790.

TURNER, ILL.—An election will be held Oct. 15 to vote on the construction of works, estimated to cost $10,000.

WARREN, ILL.—Bids will soon be asked for about three miles of pipe, with hydrants, etc. Preston T. Hicks, Cy. Engr.

MONTEVIDEO, MINN.—The citizens have voted to issue $5,000 in bonds for works.

PLYMOUTH, WIS.—The council is considering a petition of the Plymouth Water, Light & Power Co. for a franchise.

OXFORD, IA.—This town has voted to issue $8,000 in bonds for works.

GROVE CITY, MINN.—The "Times" is securing the opinion of representative business men on the question of works, and finds the sentiment strongly in favor of a good system.

BEATRICE, NEB.—This city is investigating the question of filtration. Willis Hall, Cy. Engr.

KANSAS CITY, MO.—A local paper states that the mains have not been extended for five years, and that several miles of new mains will have to be laid at once.

KIRKWOOD, MO.—The trustees are said to have agreed upon the conditions of a franchise which is about to be granted. The franchise will be for 30 years, and during the first two years the town will pay $1,000 a year for 30 fire plugs. After 1900 the town will pay $1,500 a year, or at the rate of $50 a plug. The supply will be from the Merimee River and pumped to a stand-pipe. The company is to give a bond of $10,000 to have the works completed within seven months.

GAINESVILLE, TEX.—The council is considering a resolution declaring the franchise of the Gainesville Water Co. forfeited.

PALESTINE, TEX.—The Palestine Water & Power Co. is reported about to build a new dam 1,400 ft. long, 24 ft. high, 14 ft. on top, earth embankment. H. L. Wright, Man.

RICHMOND, TEX.—The Richmond Water Works Co. has secured a site for its stand-pipe, and it is stated that works will be constructed at once. C. A. Beasley and J. M. Moore are interested.

SMITHVILLE, TEX.—A company is being organized at this place, according to reports, to construct works and an electric light plant.

ALVA, OKLA.—H. L. Jackson, Cy. Engr., has prepared plans for works at this place, for which bonds were recently voted.

COLORADO SPRINGS, COLO.—Bids are asked until Sept. 23 for constructing reservoir 8 and a portion of reservoir 7. Chas E. Smith, Cy. Clk.

GRAND JUNCTION, COLO.—Bids are asked until Oct. 8 for constructing works, as stated in our advertising columns. Engr., C. P. Allen, Denver; F. W. Cobb, Cy. Clk.

FOREST GROVE, ORE.—The citizens have voted to issue $30,000 in bonds for the construction of works.

GRASS VALLEY, CAL.—Fred M. Miller, Engr., and associates have submitted two plans for the construction of works, estimated to cost $55,000 to $60,000.

CLAREMONT, CAL.—The Union Water Co. of Claremount was incorporated Sept. 11 with a capital stock of $30,000, commencing with $500; incorporators, Archie Thompson, P. W. Eads and H. G. Kerr, of Claremont, and H. J. Nichols and H. B. Storr, of Pomona.

GALT, ONT.—A. J. McPherson, Supt., writes us that an artesian well is being bored to secure an additional water supply.

IRRIGATION.

NOGALES, ARIZ.—Press reports state as follows: Henry Criss, of Nogales, Ariz., member of the Republican National Executive Committee for this territory, has succeeded in forming a $5,000,000 syndicate to irrigate and reclaim several hundred thousand acres of so-called arid lands in Arizona, along the Mexican borders, which lie in the valley of the Santa Cruz River.

NEW COMPANY.—Snake River Land & Irrigation Co., Boise City, Idaho; $100,000; H. R. Jacket, of Deuel county, Neb.; P. J. Gerhart, Idaho Falls, Idaho; M. Patrie, J. B. Cutshaw, Market Lake.

SEWERAGE.

BRISTOL, N. H.—Surveys have been made for a system by McIntosh & Sanctuary, of Burlington, Vt. D. M. Calley, Town Clk.

RUTLAND, VT.—A trunk sewer in addition to the one now being built is proposed. Sidney Smith, Cy. Engr.; H. B. Whittier, Cy. Clk.

FITCHBURG, MASS.—Plans for sewers about six miles long are soon to be prepared. David A. Hartwell, Cy. Engr.

PROVINCETOWN, MASS.—The construction of a system of 12,000 ft. of pipe sewers, estimated to cost $18,000, including two sewage disposal plants, is being discussed.

TAUNTON, MASS.—Rudolph Hering, of New York, has been engaged as consulting engineer to report on plans for a system. Luther Dean, Cy. Engr.

WEBSTER, MASS.—A. L. Taylor, of Worcester, Mass., has completed plans for the extension of the system, estimated to cost $90,000.

BRIDGEPORT, CONN.—The board of health has recommended that the council appoint a committee of six to consider plans for a better sewer system.

PUTNAM, CONN.—Bids are asked until Sept. 26 for constructing one-quarter mile of storm water drains, as stated in our advertising columns. Engr., C. E. Chandler, Norwich, Conn.

STONINGTON, CONN.—The construction of a system is being considered.

BINGHAMTON, N. Y.—Frank Dennison, of Binghamton, has been awarded the contracts for building sewers in Mary and Schubert Sts., at $658 and $1,147, respectively. A. D. Osborn, of Binghamton, was the only other bidder.

BROOKLYN, N. Y.—Bids are asked until Sept. 26 for constructing sewers in 10 streets. A. T. White, Comr.

BUFFALO, N. Y.—Bids are asked until Oct. 2 for constructing 36 to 24-in. brick and 20 to 10-in. pipe sewers in five streets. R. G. Parsons, Secy. Dept. Pub. Wks.

FAR ROCKAWAY, N. Y.—Bids are asked until Oct. 14 for constructing about 61,000 ft. of 18 to 8-in. and 12,000 ft. of 10 and 6-in. cast iron pipe sewers, as described in our advertising columns. Engr., Alexander Potter, 137 Broadway, New York; Carl J. Schmuck, Pres. Bd. Comrs.

KINGSTON, N. Y.—Bids are asked until Sept. 27 for constructing the 2d and 9th ward trunk sewer, 14,450 ft. of brick, as stated in our advertising columns. W. Klingberg, Cy. Engr.; J. E. Diamond, Chn. Com.; Aug. Schepmoes, Cy. Clk.

NORTH TARRYTOWN, N. Y.—An election was held Sept. 17 to vote on the question of constructing sewers. Morgan Purdy, Cy. Clk.

NEW BRIGHTON, N. Y.—Bids will soon be asked for constructing 500 ft. of 20-in. iron pipe outlet sewer on piles. T. S. Oxholm, Village Engr.

NYACK, N. Y.—J. A. Haring, Engr., has recommended the construction of a system, at an estimated cost of about $200,000.

ROCHESTER, N. Y.—Bids are asked until Sept. 27 for constructing a pipe sewer in Arnett Ave. and cement sidewalk in Arnett and Monroe Aves. Thos. J. Neville, Clk. Executive Bd.

SYRACUSE, N. Y.—Bids are asked until Sept. 23 for constructing a 60 × 40-in. brick sewer in North West St. and a 15-in. pipe sewer in Belden Ave. Henry C. Allen, Cy. Engr.; H. F. Stephens, Cy. Clk.

JERSEY CITY, N. J.—Bids are asked until Sept. 24 for reconstructing 880 ft. of the 24-in. brick sewer in Third St. John C. Kaiser, Chn. Com.; Geo. T. Bouton, Clk. Comrs.

NEW BRUNSWICK, N. J.—Bids are asked by the sewer committee for constructing a brick sewer in George St.

ORANGE, N. J.—It is reported that the committee has decided to recommend to the council to reject the bids received Aug. 5 for constructing brick and pipe sewers, and advertise for new bids. The total of the bids were noted in our issue of Aug. 29. F. T. Crane, Cy. Engr.; Alpheus Struble, Cy. Clk.

PLAINFIELD, N. J.—Bids are asked until Sept. 30 for constructing sewage disposal beds, as described in our advertising columns. A. J. Gavett, Constructing Engr.; F. W. Farquhar, Consult. Engr.; James T. MacMurray, Cy. Clk.

ALTOONA, PA.—Rollins & Sons, of Boston, Mass., have purchased $280,000 of sewer bonds, part of which is for building sewers and for a sewage disposal plant. Harvey Linton, Cy. Engr.

McKEES ROCKS, PA.—Bids are asked until Oct. 8 for constructing about 5,000 ft. of 60 to 28-in. brick and about 4,800 ft. of 30 to 20-in. pipe sewers, as stated in our advertising columns. R. F. Hunter, Borough Engr.; John Zinkham, Clk. Council.

BALTIMORE, MD.—Janon Fisher, Cy. Comr., has directed that work be begun at once on the construction of the Brice Alley and the Allurion St. sewers, for which appropriations of $24,000 and $140,000, respectively, were made by the council last winter.

WASHINGTON, D. C.—Bids are asked by the district commissioners until Sept. 28 for constructing sewers, as stated in our advertising columns.

SPARTANBURG, S. C.—It is reported that an election may soon be held to decide the question of building a system about 15 miles long.

JACKSONVILLE, FLA.—Bids are asked until Oct. 15 for furnishing 179,000 ft. of 24 to 8-in. sewer pipe, and 15,700 ft. of cast iron pipe, as stated in our advertising columns. R. N. Ellis, Supt.; B. F. Dillon, Chn. Bd.

MOBILE, ALA.—Bids are asked until Dec. 2 for constructing about 22 miles of sewers, as stated in our advertising columns. L. de V. Chaudron, Cy. Clk.; W. J. Patterson, Chn. Select. Com.

HENDERSON, KY.—Bids are asked for constructing 1,200 ft. of 60-in. brick and about 1,200 ft. of 24-in. pipe sewers, through quicksand, at a depth of 13 ft. S. H. Kimmel, Cy. Engr.

DELAWARE, O.—The construction of a system is being considered, according to reports.

EVANSTON, O.—The following bids have been received by Wm. H. Krapp, 36 Carlisle Bldg., Cincinnati, for constructing house connections: Thos. A. Tierney, 134 East Court St., Cincinnati, $1,651; Wm. White & Son, Newport, Ky., $1,409; John W. Scott & Co., Aurora, Ind., $1,440; Delaney & Dawson, Dennison, Hotel, Cincinnati (awarded contract), $1,060.

GREENVILLE, O.—The citizens are to vote on the question of constructing a system.

WARREN, O.—Bids are asked until Oct. 10 for constructing about 7,084 ft. of 24 to 9-in. tile and iron pipe sewers. Homer C. White, Cy. Engr.; Albert E. Andrews, Cy. Clk.

FORT WAYNE, IND.—The council has passed resolutions for constructing 18 to 12-in. pipe sewers in 10 streets.

PONTIAC, MICH.—Bids are asked until Oct. 1 for constructing a system of 24 to 12-in. pipe sewers, as stated in our advertising columns. E. R. Webster, Secy. Comn., Pontiac.

VINCENNES, IND.—The McMath Surveying Co., of St. Louis, Mo., is preparing plans for a system. Jere Herskey, Cy. Engr.

CHAMPAIGN, ILL.—The construction of a system 28 miles long is proposed. Consult. Engr., Prof. A. N. Talbot; Joseph O'Brien, Cy. Engr.

LITCHFIELD, ILL.—About 1,500 ft. of 78 to 66-in. brick and 1,900 ft. of 15-in. pipe sewers are proposed. E. F. Harper, Cy. Engr.

QUINCY, ILL.—A committee has been appointed to confer with Hiram Phillips, of St. Louis, Mo., in regard to plans for a proposed system.

SYCAMORE, ILL.—It is proposed to construct a system. F. B. Townsend, Mayor.

APPLETON, WIS.—Bids are asked by the council until Oct. 1 for constructing 15 to 9-in. sewers in three streets, average depth, 18 to 12 ft.

DE PERE, WIS.—Foley & Connelly have been awarded the contract for constructing the first section of a system for this city, plans for which were prepared by E. L. Shaw, Cy. Engr., Marinette, Wis.

MADISON, WIS.—D. K. Tenney has prepared plans for a main sewer, to empty into Monona Lake. Plans have also been prepared by Col. Geo. E. Waring, Jr., of Newport, R. I., for a system, part of which may be constructed at an estimated cost of $65,000. McClellan Dodge, Cy. Engr.

NEENAH, WIS.—The taxpayers voted Sept. 10 to construct a system at an estimated cost of $12,000.

WAUSAU, WIS.—The council has directed the committee to advertise for bids for constructing the La Salle St. sewer.

FORT MADISON, IA.—Arrangements are being made to construct about 10,000 ft. of 30 to 10-in. pipe sewers. T. R. Robertson, Cy. Engr.

SALT LAKE CITY, UTAH.—Bids are asked until Oct. 14 for the right to use the sewage of the city for irrigation purposes, the right to include the use of 75 acres of land owned by the city at the sewer outlets. A. F. Doremus, Chn. Bd. Pub. Wks.

GALT, ONT.—A. J. McPherson, Supt. Water-Works, writes us that an election is to be held Sept. 24 to vote on the question of constructing a system, at an estimated cost of about $100,000. James M. Hood, Town Clk.

STREETS AND ROADS.

BOSTON, MASS.—Bids are asked by the Metropolitan Park Commission until Sept. 27 for building a driveway two miles long, in connection with the Mystic Valley Parkway, in Medford and Winchester. Engr,. Wm. T. Pierce, 13 Exchange St., Boston.

ORANGE, MASS.—It is proposed to construct a macadam road 1⅛ miles long. J. W. Bridge, Town Clk.

BRISTOL, CONN.—Bids are asked by the selectmen until Sept. 24 for macadamizing 2,515 lin. ft. of Riverside Ave.

BROOKLYN, CONN.—Bids are asked until Sept. 25 for macadamizing a road. John C. Williams, Selectman; address F. A. Prince, East Brooklyn.

DEEP RIVER CONN.—We are informed that the following bids were received Sept. 12 for macadamizing a road; H. G. Jones, Selectman; Moses & Gladwin, of Meriden and Essex, Conn., $2.40 per lin. ft., according to specifications; John Doolittle & Co., New Haven, Conn., $4 per lin. ft. for telford and macadam; A. A. Breyas & Son, Middletown, Conn., $2.09 for 6 ins. of telford and macadam; $1.59 for 6 ins. of macadam, or $1 for 4 ins. of macadam; Stone Road Construction Co., Bridgeport, Conn., $2.01 for 6 ins. telford and macadam, or $1.37 for 6 ins. of macadam.

EAST HADDAM, CONN.—Bids are asked until Sept. 21 for constructing a macadam road. S. S. Carter, Jr., Selectman.

PLAINFIELD, CONN.—Bids are asked until Sept. 27 for constructing a macadam road, as stated in our advertising columns. Engr., C. E. Chandler, Norwich.

PUTNAM, CONN.—Bids are asked until Sept. 26 for macadamizing a road, as stated in our advertising columns. Engr., C. E. Chandler, 161 Main St., Norwich, Conn.

SOUTH WINDSOR, CONN.—Bids are asked until Sept. 24 for constructing a telford road. C. H. Pease, Selectman.

STONINGTON, CONN.—Bids are asked until Sept. 25 for macadamizing a road at Pawcatuck. Engrs., Dabol & Crandall, 94 State St., New London; B. F. Williams, Selectman, Mystic, Conn.

VERNON, CONN.—Bids are asked until Sept. 28 for constructing a macadam road 4,500 ft. long. Amasa P. Dickinson, Selectman, Rockville, Conn.

WINDSOR, CONN.—Bids are asked until Sept. 24 for macadamizing a road. J. E. Higinbotham, Selectman, Windsor.

BROOKLYN, N. Y.—Bids are asked until Sept. 27 for paving three streets with granite blocks, and until Sept. 30 for paving St. Mark's Ave. with Belgian blocks. Alfred T. White, Comr. Cy. Wks.

NEW YORK, N. Y.—Bids are asked until Sept. 26 for furnishing 1,800 cu. yds. of crushed rock ballast for the Park Ave. viaduct for the New York & Harlem R. R. Co. Frank Bulkley, Pres. Imp'v't. Bd., 132 Park Ave.

STAPLETON, N. Y.—Bids are asked until Oct. 4 for 1,250 sq. yds. of macadam in Castleton. Franklin C. Vitt, Clk. Bd. Supervisors.

SYRACUSE, N. Y.—Bids are asked until Sept. 23 for grading Wood Ave. H. T. Stephens, Cy. Clk.

JERSEY CITY, N. J.—Bids are asked until Sept. 24 for 6,200 sq. yds. of asphalt and 6,700 sq. yds. of Belgian block paving, and for 4,250 cu. yds. of earth excavation, 8,000 lin. ft. of curbing, etc. J. C. Kaiser, Chn. Com.

BALTIMORE, MD.—Bids are asked until Sept. 23 for grading and paving Appleton St. Janon Fisher, Cy. Comr.

WASHINGTON, D. C.—Bids are asked by the district commissioners until Sept. 20 for gravelling two streets.

WASHINGTON, D. C.—The district commissioners propose next year to pave a large number of streets at an estimated cost of about $400,000.

MERIDIAN, MISS.—The town has voted to appropriate $105,000 for paving. N. M. Brandon, Cy. Engr.

COLUMBUS, O.—The council has decided to reject the bids for paving Parsons Ave. with brick and to advertise for new bids.

CLEVELAND, O.—Bids are asked until Oct. 9 for grading and paving Scoville Ave. with brick; bond, $1,000. D. E. Wright, Dir. Pub. Wks.

VAN WERT, O.—Bids are asked until Oct. 7 for macadamizing three streets. Engr., G. L. McKibben; C. F. Manship, Village Clk.

EVANSVILLE, IND.—It is reported that about 53,000 sq. yds. are to be paved with brick. Augustus Plaffiin, Cy. Engr.

LAFAYETTE, IND.—About 13,000 sq. yds. of macadam and 1,200 sq. yds. of brick paving are proposed. W. K. Eldridge, Cy. Engr.

MUSKEGON, MICH.—It is stated that the committee is about to pave Weston Ave. with brick at an estimated cost of $40,000.

CHICAGO, ILL.—Bids are asked until Sept. 25 for improving six streets. W. D. Kent, Comr. Pub. Wks.

DE KALB, ILL.—We are informed that the following bids were received Sept. 7 for 13,600 sq. yds. of paving in Main St., as advertised in Engineering News; Consult. Engr., L. B. Merriam; E. A. Porter, Cy. Clk.:

Campbell & Lennis, Joliet, Ill.	$22,904
*Rockford Construction Co., Rockford, Ill.	17,526
Chicago Paving Supply Co., Chicago, Ill.	17,629
J. B. Smith & Co., Chicago, Ill.	19,549
James Barstow, Chicago, Ill.	18,446
Lyons Construction Co., Lyons, Ia.	17,645
Talbot Paving Co., Chicago, Ill.	20,521

*Awarded contract.

LITCHFIELD, ILL.—The council proposes to pave 4,000 sq. yds. with brick. E. F. Harper, Cy. Engr.

SPRINGFIELD, ILL.—It is stated that about 10,000 sq. yds. will be paved with brick this year and the same amount next year. C. M. Rickard, Cy. Engr.

STREATOR, ILL.—It is proposed to pave about two miles with brick.

JEFFERSON, MO.—About 36,000 sq. yds. of macadamizing are proposed. E. F. C. Harding, Cy. Engr.

FORT SMITH, ARK.—The paving of 7,050 sq. yds. with brick is reported as contemplated. Engr., Jas. B. Goss.

SALT LAKE CITY, UTAH.—Bids are asked until Sept. 23 for constructing sidewalks and pipe sewers in two streets. A. F. Doremus, Chn. Bd. Pub. Wks.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

PILES.—Philadelphia, Pa.—Bids are asked until Oct. 7 for furnishing and delivering 5,500 piles at Fort Delaware, Del., as stated in our advertising columns. Maj. C. W. Raymond, U. S. Engr.

DITCH.—Monticello, Ind.—Bids will be received at this place Sept. 25 for constructing about 17 miles of ditch, consisting of a main ditch and 13 laterals, largely scraper work or small dredge. Web. P. Bushnell, Engr.

BANK EQUIPMENT.—Raleigh, N. C.—The Mechanics' Dime Savings Bank, recently organized to do business at this place, will soon begin operations, and will need vaults, safe and other equipment necessary in the business. Address Benjamin R. Lacy, Cashier.

NAVAL SUPPLIES.—Washington, D. C.—Bids are asked until Sept. 24 for supplies for the Washington and Norfolk navy yards and a quantity of pine lumber for the naval station at Key West; and until Oct. 1 for supplies for the Mare Island navy yard. Edwin Stewart, Paymaster Gen., U. S. N.

ROCK-CRUSHING PLANT.—San Francisco, Cal.—Bids are asked at the Folsom state prison, until Sept. 28, for furnishing a rock-crushing plant, consisting of engine, crushers, screens, elevators and necessary equipments, in accordance with the topographical map and general outline specifications on file with W. R. Eckart, rooms 2 and 3, 217 Sansome St., San Francisco, or at the office of Bureau of Highways, Sacramento. Brainard F. Smith, Secy. Joint Com.

TORPEDO BOATS.—Washington, D. C.—Bids were opened Sept. 10 for the construction of the three seagoing torpedo boats authorized by the last naval appropriation bill. The cost of the vessels is limited to $175,000 each, and the act provides for the construction of one of them on the Mississippi River, one on the Pacific coast, and one on the Gulf. Four bids were received—three from the Pacific coast, and one from the Atlantic; none from the Mississippi or Gulf States. The Union Iron Works, of San Francisco, offered to build one of the vessels for $175,000, two for $173,000 each, and three for $172,000 each. Wolf & Zwicker Iron Works, of Portland, Ore., offered to construct one vessel for $168,700. Moran Brothers Co., of Seattle, Wash., bid $163,350 for one boat. These offers were to build on plans furnished by the navy department. The Herreshoff Mfg. Co., of Bristol, R. I., offered to construct one or all three of the vessels at $144,000 each. This bid was for plans prepared by the company, which were submitted with the bids. The boats are to be of 180 tons each, and are to have a speed of at least 26 knots, and are to be completed in 15 months after the signing of the contract. In case the Secretary finds that he cannot construct the vessels at the points named in the bill, he is authorized to build them at any point in the United States.

CONTRACT PRICES.

BRICK AND CEDAR BLOCK PAVING.—Chicago, Ill.—The "Chronicle" states that 43 bids were received Sept. 11 for paving, some of the bids being as low as 68 cts. per sq. yd. for cedar block paving and $1.75 for brick; wooden curbing, 3 cts.; stone curbing, 20 cts. per lin. ft. These are the lowest bids ever received in this city for this work. Within a year the city has contracted for cedar block paving at $1.50 a sq. yd.

DREDGING.—Washington, D. C.—The following bids were received by Maj. Chas. E. L. B. Davis, U. S. Engrs., Sept. 9, for dredging: Virginia Dredging Co., box 446, Richmond, Va., 23.7 cts. per cu. yd. for work in Rappahannock River, and 16½ cts. for work in Urbanna Creek; G. K. Baker, Berkeley, Va., 27 cts. and 17½ cts.; John A. Curtis, Richmond, Va., 25 cts., and 16 cts.

ASPHALT PAVING.—Elmira, N. Y.—A contract for 11,260 sq. yds. of asphalt paving has been awarded to the Barber Asphalt Paving Co., at $2.89 a sq. yd.; resetting old curbing, 20 cts.; new curbing, 55 cts. a lin. ft. The amount of the contract may be increased to 14,500 sq. yds.

LEVEE WORK.—Greenville, Miss.—W. A. Everman, Secy., writes us that contracts for 600,000 cu. yds. of new levees and 300,000 cu. yds. of enlargement have been awarded as follows: Millers Bend, enlargement, to A. P. Martin, of Vicksburg, Miss., at 14.99 cts. per cu. yd.; Warfields, new, to M. J. Roach, of Memphis, Tenn., at 8.24 cts.; Homochitto, new, to Collins & Dulaney, of Mayersville, Miss., at 9.17 cts. for the upper section and 10.62 for the lower section; Albermarle, new, to Batt O'Brien, at 9.23 cts. and 8.48 cts. for the two sections.

CAST IRON PIPE.—Somersworth, N. H.—The contract for 3,880 lengths of 16 to 4-in. water pipe, as advertised in Engineering News, has been awarded to the Warren Foundry & Machine Co., at $23.90 per ton of 2,240 lbs. There were eight bids.

DREDGING.—Baltimore, Md.—Wm. L. Kenly, Acting Ch. Engr. Water Bd., informs us that the following bids were received Sept. 16 for 300,000 cu. yds. of dredging in Lock Raven, 10 miles north of Baltimore, as advertised in Engineering News: L. B. McCabe & Bro., Baltimore, Md., $142,500; Virginia Dredging Co.; J. Clements Shaeffer, Secy., Richmond, Va., $119,850; J. W. Hoffman & Co., Philadelphia, Pa., $93,000; Harbor & Inland Improvement Co., Frank Furst, Pres., $73,171.

SEWERS.—Pittsburg, Pa.—The contract for the last section of the East End drainage system was awarded to Benny & Co., of Pittsburg, at $147,602, as stated in our issue of Aug. 1, when the total bids were published. The detailed prices of this successful bid were as follows:

9-in. pipe sewer	1,590	lin. ft.	$0.90
15-in. " "	10,088	" "	1.05
18-in. " "	1,458	" "	1.40
20-in. " "	1,123	" "	1.55
24-in. " "	930	" "	2.00
2 ft. 6-in. brick sewer	856	" "	3.15
3 " 0 " B. & S. sewer	1,995	" "	3.35
3 " 4 " " " "	1,282	" "	3.90
4 " 2 " " " "	1,806	" "	4.95
4 " 6 " " " "	2,381	" "	7.20
5 " 8 " " " "	1,408	" "	8.55
6 " 3 " " " "	1,142	" "	8.90
6 " 6 " " " "	3,088	" "	9.10
7 " 0 " " " "	768	" "	9.75
9 " 0 " " " 3 rings	328	" "	16.15
9 " 0 " " " 4 "	136	" "	13.10
9 " 0 " " " 4 "	143	" "	24.35
12 " 0 " " " "	130	" "	25.40
*15" 0 " " " "	267	" "	6.55
Drops, complete	18	each	55.00
Basket drops, complete	10	"	50.00
Manholes on pipe sewers	34	"	30.00
" on B. & S. sewers	21	"	28.00
Masonry, third class	2,922	cu. yds.	3.25
Concrete	...	" "	4.75
9-in. slants on B. & S. sewer	...	each	.20
15-in. " " " " "	...	"	.35
18-in. " " " " "	...	"	.35
20-in. " " " " "	...	"	1.20
24-in. " " " " "	...	"	1.75
Plastering:			
Outside of 6 ft. 3-in. B.&S. sewer	...	lin. ft.	.30
" " 5 " 8 " "	...	" "	.25

*Bottom in Jones & Loughlin's 15-ft. culvert.

HIGHWAYS.—New York, N. Y.—The following bids were received by the Aqueduct Commissioners Sept. 13 for constructing new highways in the town of Cortlandt; engineer's estimate, $20,425:

Quantities.			R. Dooley, $17,220.	Byron & Flanagan, $21,150.	Credon & Landor, $19,688.	P. F. Curran, $16,925.	J. Twiname, $16,335.
Excavation:							
Earth	15,000	cu. yds.	$0.20	$0.30	$0.30	$0.27	$0.30
Rock	6,000	" "	.90	1.40	1.50	.85	1.10
Riprap	500	" "	1.25	1.00	1.19	1.15	1.00
Masonry:							
Dry rubble.	160	" "	2.00	3.50	2.16	3.00	2.50
Split stone.	25	" "	4.00	7.00	2.50	5.00	5.00
Ballasting*	1,300	" "	.75	.80	1.00	.65	.50
12-in. tile drain	100	lin. ft.	1.25	1.00	.60	1.25	1.00
Fencing:							
Stone wall	500	" "	.75	1.25	.72	.75	1.00
Post & rail	21,000	" "	.30	.25	.165	.25	.16

*Of stone for road foundation.

ADDITIONAL WATER CONDUIT.—Brooklyn, N. Y.—I. M. De Varona, Engr. of Water Supply, informs us that the following bids were received Sept. 10 for laying 48-in. pipe, etc., for section 1 of the new additional pipe conduit, as advertised in Engineering News; all bidders except J. W. Hoffman are residents of Brooklyn:

Bids for Additional Water Conduit, Brooklyn, N. Y.

Quantities.		Stratford & Hawkes, 329 Flatbush Ave.	J. P. Cranford & Sons, 16 Court St.	M. J. Daly, 218 Schermerhorn St.	JohnMcNamee, 237 Jefferson Ave.	J. W. Hoffman, 42 Wall St., New York.	Robert Furey, 10 Eighth Ave.
Earth excavation	1,500 cu. yds.	$0.80	$0.28	$0.60	$0.30	$0.80	$0.30
Concrete	80 " "	5.00	4.70	7.00	5.00	7.00	4.75
Brick masonry	190 " "	8.00	9.25	12.00	8.50	11.50	9.25
Rubble masonry	70 " "	4.50	6.75	8.00	6.00	6.00	6.25
Rock dressed ashlar masonry	70 " "	10.00	28.50	22.00	30.00	12.00	30.00
Dimension stone masonry	10 " "	40.00	32.50	54.00	33.00	30.00	30.00
Coping	30 sq. yds.	1.75	18.50	6.00	20.00	6.00	19.00
Six cut dressing	800 sq. ft.	.40	.75	.50	.70	.50	.80
Spruce lumber	20 M. ft.	20.00	19.00	22.00	18.00	21.00	20.00
Double line of 48-in. pipe to lay	4,440 lin. ft.	9.75	7.75	18.10	6.80	8.90	7.20
Gate house, superstructure complete	...	3,000	1,350	1,018	1,100	800	1,300
Total		$50.877	$41,808	$87,702	$37,362	$45,786	$39,470

WATER TUBE BOILERS.—Washington, D. C.—The following bids were received Sept. 4 for water tube boiler for the House wing of the Capitol building:

Campbell & Zell Co., Baltimore, Md.	$3,232
Babcock & Wilcox Co., New York	$3,255 and 4,100
Morton, Reed & Co., Baltimore, Md.	3,100
James Beggs & Co., New York, N. Y.	3,400
National Water Tube Boiler Co., New Brunswick.	2,634

The boiler is to be furnished and set in place complete, and is required to be of the sectional water tube type, with two furnace doors, and to be similar and in every respect equal to those now in use in the capitol, and to have a capacity of not less than 150 HP. The horse-power is to be upon the basis of 30 lbs. water evaporated from a temperature of 100° F., at 70 lbs. per hour, per HP. This boiler must be entirely self-sustaining and properly secured, so that it shall be entirely independent of the surrounding brickwork.

allowing ample provision for expansion and contraction, and that the brickwork may be removed at any time when required without disturbing the boiler, or connections to the same. The sections and mud drums to be tested and made tight under a hydraulic pressure of 300 lbs. per sq. in. The steam and water drums to be tested and made tight under a hydraulic pressure of 150 lbs. per sq. in., and all to be tested after being set up complete, ready for use, under a steam pressure of 150 lbs. per sq. in. The front and fittings are to be of an ornamental pattern, corresponding with those now in use, and all the work will be subject to such modification as the architect may require during the process of construction. All material and labor required for the proper erection of the boiler will be furnished by the contractors, including any brick of a special pattern that may be required, and also all necessary arrangements for connections with the main steam pipes. The said mains, and all necessary work connected with the foundations and flues, will be furnished by the government, but under the direction and superintendence of the contractors. The contractors will furnish the necessary bricks and construct the boiler walls proper, including, also, the furnaces of fire bricks, subject to the inspection and approval of the architect. All bidders must furnish drawings and specifications, after examining location and condition, the same being subject to the approval of the architect, the contractors also giving a guarantee to keep the boiler in repair for the term of five years, except only in case of known negligence or incapacity of attendants. The boiler to be set up ready for use on or before Nov. 1, 1895.

LAYING WATER MAIN.—Brooklyn, N. Y.—The following bids were received Sept. 6 for laying a 48-in. distributing main, as advertised in Engineering News:

Bids for Laying a 48-in. Water Main, Brooklyn, N. Y.

Quantities.		M. J. Daly.	John McNamee.	*J. W. Hoffman & Co.	J. F. Cranford & Co.	Robert Furey.	Thos. McCann.	*Henry McTighe.	Stratford & Hawkes.	Harris & Maguire.
Extra excavation	2,400 cu. yds.	$0.60	$0.50	$0.60	$0.55	$0.55	$0.50	$1.00	$0.50	$1.00
48-in. pipe	35,740 lin. ft..	2.43	2.90	2.90	2.98	2.90	3.00	3.25	3.35	3.70
36-in. "	5,880 " "	2.00	2.30	2.10	2.50	2.52	3.00	2.62	2.00	2.34
30-in. "	6,000 " "	1.75	1.40	1.40	1.35	1.36	2.50	1.90	2.70	1.75
24-in. "	500 " "	1.50	.90	.90	1.00	1.00	2.00	1.45	1.50	.85
20-in. "	100 " "	1.00	.50	.75	.45	.47	.75	.75	.70	.60
12-in. "	100 M.....	20.00	16.00	22.00	15.00	15.00	20.00	14.00	15.00	20.00
Brick, per M.	10 cu. yds.	7.00	4.00	8.00	6.00	6.00	10.00	6.00	4.00	6.00
Rubble masonry	80 " "	7.00	5.00	7.00	4.60	4.80	6.00	4.50	4.50	5.00
Concrete	500 lbs....	.15	.12	.05	.12	.15	.10	.05	.04	.10
Bands and bolts	300 cu. yds.	.60	.50	.60	.45	.40	.50	.40	.50	.50
Extra fill										
Total		$115,903	$130,790	$131,024	$134,508	$134,936	$146,265	$149,206	$159,009	$163,392

* New York; all other residents of Brooklyn.

CEMENT AND BROKEN STONE.—Washington, D. C.—The folowing bids were opened Sept. 13, at the office of the U. S. Engineer, for furnishing and delivering cement and broken stone at Fort Washington, Md., and Fort Monroe, Va., as advertised in Engineering News:

American cement:	Ft. Wash., 1,950 bbls.	Ft. Monroe, 1,100 bbls.
James H. McGill, Washington, D. C....	$0.89	$0.89
B. Wallis & Co., Baltimore, Md.....	1.18	1.18
Gen. E. & Eng. Co., Philadelphia, Pa..	1.42¾	1.46¾
Nat. Bldg. Supply Co., Baltimore, Md..	0.96	0.97
Lawrenceville Ct. Co., New York, N. Y.	0.89	0.87
N. Y. & Ros. Ct. Co., New York, N. Y..	0.94¾	0.94¾
J. W. Walker Sons, Washington, D. C..	1.18	1.25

Portland cement:	Ft. Wash., 160 bbls.	Ft. Monroe, 625 bbls.
Jas. H. McGill, Washington, D. C.....	$2.37	$2.37
H. A. Jones, Washington, D. C.....	2.49	2.49
B. Wallis & Co., Baltimore, Md.....	2.40	2.40
Nat. Bldg. & Supply Co., Baltimore, Md..	2.29	2.34
J. T. Walker Sons, Washington, D. C...	2.50	2.50
Sinclair & Babson, New York, N. Y.....	2.37	2.36
E. Thiele, New York, N. Y.....	2.74	2.84
Atlas Cement Co., New York.....	2.12	2.12
James Brand, New York, N. Y.....	2.90	2.88
E. A. Holmberg, New York, N. Y.....	2.60	2.65
Jacob Heffelfinger, New York.....	....	2.90

Broken Stone for Fort Washington.—250 cu. yds. of fine broken stone and 175 cu. yds. granolithic broken stone:

	Granolithic, cu. yd.	Fine, cu. yd.
Chas. G. Smith & Sons, Washington, D. C.	$2.08	$1.88
Wm. Turner, New York, N. Y.....	2.50	2.00

Broken Stone for Fort Monroe, Va.—750 cu. yds. fine broken stone and 100 cu. yds. granolithic broken stone:

	Granolithic, cu. yd.	Fine, cu. yd.
Chas. G. Smith & Son, Washington, D. C.	$2.58	$2.33
Smith & Chappel, Richmond, Va.....	3.50	3.00

10,000 Brick for Fort Washington, Md.:
John Miller, Washington, D. C.....$12.00 per M.

STEEL AND IRONWORK.—Boston, Mass.—The contract for the steel and ironwork for section 2 of the subway has been awarded to the Pennsylvania Steel Co. The amount to be furnished has not been definitely fixed, but the maximum amount which may be required by the specifications is 1,249 tons. The bids were as follows; B. Leighton Beal, Secy. Comm.:

	Per 2,000 lbs.
The King Bridge Co., Cleveland, O.....	$64.50
Passaic Rolling Mill Co., Paterson, N. J.....	61.00
The Carnegie Steel Co., Pittsburg, Pa.....	60.00
A. & P. Roberts Co., 261 So. 4th St., Philadelphia.	59.55
Edge Moor Bridge Works, Wilmington, Del.....	58.75
Pennsylvania Steel Co., Steelton, Pa.....	58.70

BRICK AND GRANITE PAVING.—Newark, N. J.—The contract for brick paving in Roseville Ave. has been awarded to Terence McManus, of Newark, as follows: 30,000 sq. yds. of Mack repressed fireclay, crude block paving, $2.15 per sq. yd.; 300 sq. ft. of bridging at 60 cts.; 8,400 sq. ft. of curb reset at 21 cts.; 500 ft. of new 20-in. curb at 65 cts.; five sets of new 20-in. corners at $9 each; six basins at $50 each, and 26 manholes at $14 each; total, $46,078. The contract for paving a portion of 15th Ave. with granite blocks has been awarded to John F. Shanley, at $2.12 per sq. yd.; bridging, 47 cts. per sq. ft.; total, $31,322.

BRICK PAVING.—Greensburg, Pa.—The contract for paving West Otterman St. has been awarded to G. W. Good & Co., at $10,388. Mack and Park repressed brick to be used. The bids were as follows:

	Curbing 3,700 ft.	Grading 2,000 cu. yds.	Paving 7,000 sq. yds.
T. B. Townsend, Zanesville, O...	$0.45	$0.25	$1.10
G. W. Good & Co., Greensburg...	0.44	0.25	1.17
Byron Husband, Greensburg.....	0.49	0.26	1.23
McCon & Bennett, Greensburg...	0.48	0.28	1.25
James White, Greensburg.....	0.47	0.30	1.36

CEDAR BLOCK PAVING.—Milwaukee, Wis.—The following additional contracts have been awarded for paving with cedar blocks: Washington St., from Reed St. to Clinton St., to John T. Hoff, at 96 cts. a sq. yd.; Cherry St., from 20th St. to 24th St., to Joseph Polczyinski, at 92 cts. a sq. yd.; curbing at 37 cts. a ft.; State St., from 3d St. to 7th St., to Wells, Reichert & Co., at 94 cts. a sq. yd.; curbing, 51 cts. a lin. ft.

MANILA ROPE AND DREDGING.—New York, N. Y.—The dock board has awarded a contract for manila rope to John Early, at 67 cts. per 100 lbs. The only bid received Sept. 10 for dredging was that of Wm. Tebo, at 23 cts. a cu. yd., and this was rejected as too high.

REMOVING SHOALS.—Detroit, Mich.—Col. O. M. Poe, U. S. Engineer Office, received the following bids Sept. 6 for removing shoals, as advertised in Engineering News:

Removing Shoals from West Approach, St. Mary's Falls Canal.

	Earth excav., 90,700 cu. yds.	Rock excav., 2,000 cu. yds.	Total.
Dunbar & Sullivan, Buffalo, N. Y.	$0.28	$10.00	$45,396
Morris G. Dodge & Sons, Chicago..	0.50	2.00	49,350
Hickler Bros., Sault Ste. Marie....	0.65	1.65	62,255
W. A. McGillis & Co., Chicago....	0.63	3.75	64,641
E. J. Hingston, Buffalo, N. Y.....	0.98	1.90	92,686
Buffalo Drdg. Co., Buffalo, N. Y..	1.45	1.45	134,415
Carkin, Stickney & Cram, Detroit.	1.50	1.50	139,050
R. J. Cram, Detroit, Mich.....	0.87½	....	79,632

Removing Shoal from East Approach, St. Mary's Fall Canal.

	Earth excav., 11,970 cu. yds.	Total.
W. A. McGillis & Co.	$0.14½	$1,736
Hickler Bros.	0.18	2,155
C. E. Mitchell & Co., Ludington, Mich.	0.21	2,514
Julius Hess, Detroit, Mich.....	0.22	2,633
B. J. Cram.....	0.24	2,873
Dunbar & Sullivan.....	0.32	3,830
Edward J. Hingston.....	0.79	9,456
Buffalo Dredging Co.....	0.95	11,371

Removing Shoals off Six-Mile Point, Hay Lake.

	Earth excav., 348,554 cu. yds.	Total.
W. A. McGillis & Co.....	$0.10¼	$35,727
A. H. Vogel, Milwaukee, Wis.....	0.10 9-10	37,992
Racine Dredge Co., Racine, Wis.....	0.11	38,341
Julius Hess	0.11½	40,084
Dunbar & Sullivan.....	0.11 6-10	40,432
C. S. Barker, West Superior, Wis...	0.11⅞	41,391
L. P. & J. A. Smith Co., Cleveland, O.	0.12	41,826
C. E. Mitchell & Co.....	0.12 7-10	44,246
Wm. A. Starke, Milwaukee, Wis....	0.12 8-10	44,615
Hickler Bros.....	0.15	52,283
Walter S. Daley, Ogdensburg, N. Y..	0.21	75,196
R. J. Cram.....	0.22½	78,425
Edward J. Hingston.....	0.22½	78,425
Buffalo Dredging Co.....	0.40	139,422
Carkin, Stickney & Cram.....	0.45	156,849

Removing Shoal 29, Section 4, Ship Channel, Etc.

	Earth excav., 8,000 cu. yds.	Rock excav., 500 cu. yds.	Total.
W. A. McGillis & Co.....	$0.65	$7.00	$7,075
John Hickler	0.95	6.00	10,600
Hubbell & Stone, Saginaw, Mich.	1.15	6.00	12,200
Dunbar & Sullivan.....	0.90	12.00	13,200
Edward J. Hingston.....	1.25	6.50	13,250
Hickler Bros.....	1.25	7.00	13,500

ELECTRIC CRANE.—St. Louis, Mo.—The following bids were received Sept. 6 for a 20-ton traveling crane:

Pawling & Harnischfyer, Milwaukee, Wis.....	$4,600
Morgan Engineering Co., Alliance, O.....	8,400
American Hoist & Derrick Co., St. Paul.	$5,887 and 5,339
Phoenix Iron Works Co., Cleveland, O.....	4,222
Manning, Maxwell & Moore, Chicago.....	5,870
Whiting Foundry Equipment Co., Chicago.....	6,355

METAL MARKET PRICES.

LEAD.—New York: 3.35 to 3.37 cts. Chicago: 3.32 to 3.3 cts. St. Louis: 3.2 cts.

BARB WIRE.—Pittsburg: $2.70 and $2.80 for galvanized, and $2.30 and $2.40 for painted in carload and less than carload lots at mill.

FOUNDRY AND PIG IRON.—New York: $12.25 to $14. Pittsburg: $12.75 to $13.75. Chicago: $13 to $14.50.

TRACK MATERIAL.—New York: angle bars, 1.4 to 1.5 cts.; spikes, 1.8 to 1.85 cts.; track bolts, 2 to 2.2 cts. with square, and 2.1 to 2.2 cts. with hexagon nuts. Chicago: angle bars, 1.75 to 1.8 cts.; spikes, 1.9 to 2 cts.; track bolts, 2.3 to 2.45 cts. with square and 2.5 to 2.65 cts. with hexagon nuts.

NAILS.—Pittsburg: $2.25 per keg for carload lots and $2.35 for less than carload lots, for wire nails at mill; $1.80 and $1.85 for cut nails at mill. Chicago: $2.40 and $2.50 for wire nails, $2 and $2.05 for cut nails. New York: $2.40 and $2.50 for wire nails, and $1.95 and $2.05 for cut nails.

RAILS.—New York: $28 at eastern mills and $28.75 at tidewater; old rails, $13.50 to $15.50 to $16 for iron, and $13.50 to $14 for steel; light rails, $26 to $28; girder rails, $26. Pittsburg, $28 for standard sections of 45 lbs. and over; $28 for light sections; old rails, $19.75 for iron and $17 for steel. Chicago: $27 to $31 for standard sections; $28 for light sections; old rails, $17.50 to $19 for iron, and $14 to $15 for steel.—The steel rail manufacturers' association, at its meeting last week, made an advance in prices of $4 per ton at mill.

STRUCTURAL MATERIAL.—New York: beams, 1.8 to 2.2 cts.; channels, 1.85 to 2 cts.; angles, 1.65 to 1.8 cts.; tees, 1.85 to 2 cts.; universal mill plates, 1.9 to 1.95 cts.; steel plates, 1.95 to 2 cts. for tank, 2 to 2.1 cts. for shell, 2.1 to 2.25 cts. for flange, 2.4 to 2.5 cts. for ordinary firebox, 2.6 to 2.75 for locomotive firebox. Pittsburg: beams, 1.6 to 2 cts.; channels, 1.6 to 2 cts.; angles, 1.5 to 1.6 cts.; tees, 1.6 to 1.7 cts.; Z-bars, 1.6 to 1.7 cts.; universal mill plates, 1.8 to 1.9 cts.; steel plates, 1.9 to 2 cts. for tank, 2 to 2.1 cts. for shell, 2.1 to 2.2 cts. for flange, 2.5 cts. for ordinary firebox, 2.5 to 4 cts. for locomotive firebox. Chicago: beams, 1.75 to 1.9 cts.; channels, 1.75 to 1.9 cts.; angles, 1.75 to 1.85 cts.; tees, 1.95 to 2 cts.; universal mill plates, 2.15 to 2.25 cts.; steel plates, 2.1 to 2.3 cts. for tank, 2.35 to 2.5 cts. for flange, 2.8 to 2.9 cts. for ordinary firebox, 4.5 to 4.75 cts. for locomotive firebox.

INDUSTRIAL NOTES.

THE INDIANA BRIDGE CO., of Muncie, Ind., will add to its plant a foundry for architectural ironwork.

THE RATHBUN CO., of Deseronto, Ont., has an order for 85 platform cars and 35 box cars for the Intercolonial Ry.

THE HOWARD HARRISON IRON CO., of Bessemer, Ala., has put in a set of coke ovens, with apparatus for utilizing the by-products.

THE MADISON CAR CO., of Madison, Ill., has an order for 200 box and 300 coal cars for the Union Pacific, Denver & Gulf R. R.

THE MICHIGAN-PENINSULAR CAR CO., of Detroit, Mich., is building 600 coal cars for the Cleveland, Lorain & Wheeling R. R.

THE CALUMET IRON & STEEL CO., of Chicago, Ill., is having its bar mills and ironworks overhauled with a view to starting up work.

THE GOLD CAR HEATING CO., of New York city, has a contract for equipping the cars of the Broadway cable railway with its heating system.

THE LEWIS FOUNDRY & MACHINE CO., of Pittsburg, Pa., has completed an unusually large continuous rod mill for the Illinois Steel Co.

THE BARNEY & SMITH CAR CO., of Dayton, O., has orders for 200 gondola cars for the Washington Coal & Coke Co., of Washington, W. Va.

SUTTON & GIBSON, of Pittsburg, Pa., have the contract for the masonry work of the Carnegie Steel Co.'s new bridge at the Edgar Thompson steel works.

THE BARNETT & RECORD CO., of Minneapolis, Minn., has the contract for a 23-stall roundhouse for the Duluth & Iron Range R. R. at Two Harbors, Minn.

THE HASKELL & BARKER CAR CO., of Michigan City, Ind., is building 1,500 box cars for the Great Northern R. R. The wood used is Washington fir, with cedar for the roofs.

THE M. C. BULLOCK MFG. CO., of Chicago, Ill., has sold five diamond drills and the equipment for drilling holes 800 ft. deep to Reed Bros., of Johannesburg, South Africa.

THE GILLETTE-HERZOG MFG. CO., of Minneapolis, Minn., has the contract for steel roof trusses for a 23-stall roundhouse for the Duluth & Iron Range R. R. at Two Harbors, Minn.

GEO. A. WALKER, Security Building, St. Louis, Mo., has the contract for a pump of 35,000 gallons capacity for the water supply of the Southern Illinois Penitentiary, at Chester, Ill.

THE SCHENECTADY LOCOMOTIVE WORKS, of Schenectady, N. Y., has orders for 9 engines for the Houston & Texas Central R. R., and 3 for the Chicago & Northwestern R. R.

THE ST. CHARLES CAR CO., of St. Charles, Mo., is building 2 passenger cars, 2 baggage and smoking cars and 2 mail and express cars for the Choctaw, Oklahoma & Gulf R. R.

THE WABASH BRIDGE & IRON CO., of Wabash, Ind., has nearly completed the ironwork for its new buildings, and expects to have the machinery in place and in operation this autumn.

THE AMERICAN BRAKE-BEAM CO., Monadnock Block, Chicago, Ill., has bought out the business of the American Nut Lock Co., and will manufacture this nut-lock at its shops at Waukegan, Ill.

THE PITTSBURG LOCOMOTIVE WORKS, of Pittsburg, Pa., has orders for 10 ten-wheel engines for the Lake Shore & Michigan Southern R. R., and 2 eighty-ton engines for the Junction R. R. of Pittsburg.

THE OHIO FALLS CAR MFG. CO., of Jeffersonville, Ind., is building 50 stock cars, 36 ft. long, for the Des Moines, Northern & Western R. R., and 200 ventilated box cars for the Memphis & Charleston R. R.

THE CALUMET BLAST FURNACE CO., of Chicago, Ill., has started up its plant and has 200 men at work. The furnaces have been shut down since 1892, when they were abandoned by the Calumet Steel & Iron Co.

THE MOUNT VERNON CAR MFG. CO., of Mount Vernon, Ill., is building box cars and 400 drop-bottom gondola cars for the Louisville & Nashville R. R., and 150 coal cars for the Cleveland, Lorain & Wheeling R. R.

THE RHODE ISLAND LOCOMOTIVE WORKS, of Providence, R. I., is building for the Boston & Maine R. R. five eight-wheel engines, with driving wheels 68 ins. diameter, cylinders 19×24 ins. and boilers 60 ins. diameter.

THE PENNSYLVANIA TUBE CO., of Pittsburg, Pa., has leased a lap-welded furnace from the Pittsburg Tube Co. in order to increase its manufacturing capacity, its own plant having an annual capacity of 150,000 tons of ⅛-in. to 24-in. pipe.

THE STILWELL-BIERCE & SMITH-VAILE CO., of Dayton, O., has the contract for all pumping machinery, boilers, heaters, etc., for the Columbiana, Millersburg and Dalton, O., water-works plants, for which contracts have just been let.

THE RICHMOND LOCOMOTIVE WORKS, of Richmond, Va., is building 8 engines for the Southern R. R., 5 compounds for the Chesapeake & Ohio R. R., 2 engines for the Augusta Southern R. R., and 1 for the Seattle, Lake Shore & Eastern R. R.

THE BROOKS LOCOMOTIVE WORKS, of Dunkirk, N. Y., is building 5 ten-wheel engines for the Chicago, Rock Island & Pacific Ry., 5 for the Mexican Central Ry., and 4 for the Oregon Ry. & Navigation Co.; also 14 mogul and 4 switching engines for the Illinois Central R. R.

THE NEW YORK EQUIPMENT CO., of New York, N. Y., has given an order for 10 passenger cars for the Tehuantepec Ry. to the Jackson & Sharp Co., of Wilmington, Del., and an order for 10 box cars and 40 flat cars for the Jamaica Ry. to the Ramapo Iron Works, Ramapo, N. Y.

THE BLOOMSBURG CAR MFG. CO., of Bloomsburg, Pa., is building 200 coal cars for the Lehigh Coal & Navigation Co., 100 cars for the H. C. Frick Coke Co., and narrow gage box cars for South America. It is also building a number of the Lockhart rotary dump cars for contract work.

THE ELECTRIC FIREPROOFING CO, of New York city, has satisfied the Navy Department as to the efficiency of its process, and wood treated by this process (Eng. News, Jan. 24, 1895) is to be used for the fittings of the "Iowa" and "Brooklyn." The company's office is in the Bradley & Currier Building, corner of Hudson & Spring Sts.

THE NEAFIE & LEVY SHIP AND ENGINE BUILDING CO., of Philadelphia, Pa., has a contract for a twin-screw steamer 142 ft. long, with triple expansion engines, for Menendez & Co., of Havana, Cuba; and a contract for a twin-screw steamer 250 ft. long, 47 ft. beam and 13 ft. deep, for the Hartford & New York Transportation Co.

THE BERGER MFG. CO., of Canton, O., manufacturing metal roofing, etc., will erect for its galvanizing department a building 52 × 450 ft. of sheet iron and tile. Contracts for machinery have already been let, and work on the building will be commenced at once. The works will start out with a capacity of 4,000 tons per year, but this will probably be doubled in the near future.

THE KNOWLES STEAM PUMP WORKS, of New York city, writes us in regard to the recent fire at its works in Warren, Mass., that the fire was confined to the iron foundry and one of the pattern houses, and that the total loss will not exceed $140,000, which is fully covered by insurance. The facilities are such that very little, if any, interruption will be caused to the business by this fire.

THE BERLIN BRIDGE CO., of East Berlin, Conn., will design and build the new car barn for the Hartford St. Ry. Co., of Hartford, Conn. The office will be in the front end of the building, on State St., with the barn in the rear. The whole construction is to be of steel and fireproof, the roof being covered with the company's patent anti-condensation corrugated iron roof covering. It has also completed for the Geo. W. Stafford Mfg. Co., Providence, R. I., a new machine shop, 50 × 174 ft., two stories high. The building is constructed of brick and iron, and is so designed that two additional stories may be added in the future. The company has also completed a new car barn 86 × 188 ft. for the New Haven St. Ry. Co.; the roof is covered with slate.

WATER-WORKS APPLIANCES.—The following exhibits were made at the annual meeting of the New England Water-Works Association, at Burlington, Vt., Sept. 11, 12 and 13. The exhibits were in charge of Mr. W. H. Lang, of Lang, Goodhue & Co., Burlington:

Valves and Hydrants.—Peet Valve Co., Boston; Chapman Valve Manufacturing Co., Boston; R. D. Wood & Co., Philadelphia; Ross Valve Co., Troy, N. Y.

Meters.—Pittsburg Meter Co., East Pittsburg, Pa.; Thomson Meter Co., Brooklyn; Neptune Meter Co., New York; National Meter Co., New York; Hersey Manufacturing Co., Boston.

Pipe-Tapping Machines.—Anthony P. Smith, Newark, N. J.; Walworth Manufacturing Co., Boston.

Pipe-Cutting Machines.—Walworth Manufacturing Co., Boston; Benj. C. Smith, New York.

Service Pipe.—Lead-Lined Iron Pipe Co., Wakefield, Mass.

General Supplies.—H. Mueller Manufacturing Co., Decatur, Ill.; Walworth Manufacturing Co., Boston.

Steam Gages.—Crosby Steam Gage & Valve Co., Boston.

Flexible Joints.—J. G. Falcon, Evanston, Ill.

NEW COMPANIES.—International Air Power & Refrigerating Co., New York city; $50,000, with $50 paid in; John D. Moran, J. G. Baldwin, Jr., and W. F. Hutchinson.

Chicago Water Heater Co., Chicago, Ill.; $10,000; B. W. Sherman, Samuel K. Hibben and John L. Jackson.

American Railway Supply Co., St. Louis, Mo.: $10,000; James B. Thomas, James L. Leprelle and Eugene F. Williams.

Dickenson, & Randall Rail Joint Box Co., Alexandria, Va.; $50,000; Charles Dickenson, J. C. Watson and R. P. Brown.

Whitehill Engine & Pictet Ice Machine Co., Newburg, N. Y.; Edgar A. Penney, Robt. Whitehill and Colonel Dickey.

Union Transit Co., Dunkirk, N. Y.; navigation on the Great Lakes; $200,000; H. C. Frend, John Gordon and Theodore H. Meyer.

Buffalo Chemical Fire Extinguisher Co., Buffalo, N. Y.; $15,000; Frank L. Bapst, Wm. H. Kinch, and George P. Lynd, Jr.

Potsdam Mining Co., Potsdam, N. Y.; $50,000; W. H. Stewart, of Cohoes; F. M. Moore, and E. A. Everett, of Potsdam.

Big Sandy Coal Co., Catlettsburg, Ky.; $200,000; Pres., John C. C. Mayo, Paintsville, Ky.; Secy., C. K. Lawrence, Ashland, Ky.

O'Connell & Hillery Lime & Marble Dust Co., Tuckahoe, N. Y.; $50,000; James O'Connell, Benjamin F. Hillery and John J. Bell.

Costa Rico Land Improvement & Irrigation Association, Portland, Ore.; $100,000; R. McC. Michler, W. F. Hall and Cornelius Beal.

Horseheads Brick Co., Horseheads, N. Y.; $50,000; George Brand and Louis Dahl, of Elmira; Richard D. Eisenhard, of Horseheads.

Albert Edwards Car-Fender Co., Brooklyn, N. Y.; $100,000; Albert Edwards, 26 Court St., Brooklyn, and Walter J. Thorn, Brooklyn.

Chorman Mfg. Co., Pittsburg, Pa.; $5,000, with $500 paid in; railway supplies and station indicators for cars; Treas., Wm. H. Baird.

Pittsburg Smelting & Refining Co., Pittsburg, Pa.; Pres., Jas. T. Buchanan; Vice-Pres., Joseph McDermott; Secy. and Treas., Justice Muiert.

Columbia Tube Co., Camden, N. J.; $10,000, with $1,000 paid in; Edward E. Coleman, Chas. D. Cramp and W. J. Haines, all of Philadelphia, Pa.

Scott Gas Regulator Co., New York city; $25,000; Walter G. Scott, and John H. Jenks, of New York; Joseph A. Skeppestedt, of Brooklyn, N. Y.

Klymer Mfg. Co., Greenburg, N. Y.; to manufacture varnishes, etc; $1,000; William Murray, Eliza Roberts and Lydia North, of Brooklyn, N. Y.

Manhattan General Construction Co., New York city; to manufacture electrical apparatus; $100,000; Charles B. Hill and Benjamin A. Gould, Jr., 43 Cedar St.

Hoffman Machine Co., New York city; $250,000, with $500 paid in; lathes and metal-turning machines; R. L. Shainwald, E. G. Hoffman and Alfred W. Kiddle.

Mobile Transatlantic & Terminal Co., Jersey City, N. J.; $100,000; Henry Draper, of Hoboken; Wm. T. Hayward, of Newark, and Arthur Van Brunt, of Newton.

Wright Steam Engine Works, Newburgh, N. Y.; $200,000; Samuel McMillan, Thomas Diamond and W. G. McCrea, 158th St. and Third Ave., New York city.

Mt. Diablo Pottery & Paving Brick Co., Antioch, Cal.; $100,000; E. G. Nettleton, of Antioch; E. L. Cave, of San Francisco; George Rushforth, of Stockton.

British-American Ball Nozzle Co., New York city, $800,000; James McNeill and Ralph T. Rokeby, 130 Fulton St., New York, and Chas. A. Hendrickson, Jamaica, L. I.

Hudson River Wood-Pulp Mfg. Co., Olive, N. Y.; $15,000; Otis Leroy, 112 West 31st St., New York city; Geo. W. Banks, of Mt. Kisco, N. Y.; and J. C. Schrader, of Dover, N. J.

RECORDS AGAIN BROKEN.

Engineering News of Sept. 12 contained 141 ins. of proposal advertisements, every advertisement published having been sent to this office by an official with an order for its insertion in our columns. The advertisements thus sent us included the following:

	Bids close.
Riprap work on Swinburne Island, N. Y. H.	Sept. 13
Brick paving, St. Joseph, Mich.	Sept. 14
Paving, Ansonia, Conn.	Sept. 16
Water pipe, Westwood, O.	Sept. 16
Laying water pipe, Westwood, O.	Sept. 16
Stand-pipe, Somersworth, N. H.	Sept. 16
Laying water-pipe, Somersworth, N. H.	Sept. 16
Pumping machinery, Somersworth, N. H.	Sept. 16
Boilers, Somersworth, N. H.	Sept. 16
Paving, Dunkirk, N. Y.	Sept. 17
Water pipe, Hawaiian Government.	Sept. 17
Sale of dredge, New York, N. Y.	Sept. 18
Paving, North Haven, Conn.	Sept. 19
Paving, Seymour, Conn.	Sept. 19
Steel bridges (2 advs.), Providence, R. I.	Sept. 19
Sale of tug, etc., Newport, R. I.	Sept. 19
Subway, Boston, Mass.	Sept. 19
Railway construction, in Ohio.	Sept. 20
Passenger elevator, Paris, Tex.	Sept. 20
Bridge, Niagara Falls, N. Y.	Sept. 20
Water-works plans, Tippecanoe City, O.	Sept. 21
Sewers, Woodstock, N. B.	Sept. 25
Conn. state roads (5 towns),	Sept. 16 to Sept. 26
Water-works, Elmwood, Ill.	Sept. 26
Paving, Ansonia, Conn.	Sept. 26
Public building work, Allegheny, Pa.	Sept. 27
Water-works, Cold Spring, N. Y.	Sept. 27
Cement, Washington, D. C.	Sept. 28
Water-works, Ephrata, Pa.	Sept. 28
Water-works, Bond Hill, O.	Sept. 30
Dredging, Port Huron, Mich.	Oct. 1
Electric light plant, Mt. Sterling, O.	Oct. 1
Water-works, Mt. Sterling, O.	Oct. 1
Pumping engine, Washington, D. C.	Oct. 21
State capitol, Olympia, Wash.	Nov. 19

RECENT LETTERS.

We continue to receive letters from subscribers and others showing that the Construction News department of Engineering News is being more and more appreciated, and that those engineers and city officials who advertise their work in this paper find this the most efficient as well as the most economical method of bringing proposed work to the attention of desired parties.

The following extracts are from letters which have recently been received:

AN INTERESTING DEPARTMENT.

"I enclose several news items for your Construction News columns, which I find a growing and very interesting addition to your journal."

WILL TRY TO DO BETTER.

"I regret that I did not send you earlier information, as the newspaper reports (your only available source of information) were incorrect, but I will try to send you early notice hereafter of all our proposed work."

MORE THAN 100 INQUIRIES.

"We received something over 100 inquiries in reply to our advertisement in Engineering News."

CAUSES LIVELY COMPETITION.

"The board was very much pleased with the result of our letting, and attributed the lively competition chiefly to the advertisement published in your largely-circulated paper."

CAUSES TOO MUCH COMPETITION.

"I enclose a notice of letting for building a short extension of our railway. We should have advertised this work in Engineering News, but we did not care to be worried by possibly some 200 contractors writing for specifications and expecting replies. I have been a subscriber to the News off and on for 20 years."

IT ALWAYS PAYS.

"You will find enclosed a schedule of the bids received for our water-works. The much-to-be-desired competition was secured. The committee admits that it pays to advertise, and is well pleased with the result of its advertisement in Engineering News."

FAR BEYOND ANTICIPATION.

Warren, Ill., Sept. 5, 1895.

Engineering News Publishing Co.,
New York City.

Gentlemen: Enclosed find report of water-works letting. We were well pleased with our advertisement in Engineering News. I received over 40 applications for specifications, which was far beyond my anticipation for a job of only $7,800.

Yours truly,

Preston T. Hicks,
City Engineer.

VALUABLE ITEMS.

Much of the very best information published in our Construction News comes to us from subscribers who send items in reference to work with which they are connected or in which they are interested. Such reliable items are not only greatly desired by us but frequently result in much good to the sender by bringing his name and his work to public attention. If you are not already doing so we ask you, hereafter, to send us the earliest possible information of work that comes under your notice.

GIVE CREDIT.

We ask our readers to state whenever writing in regard to a news item or a proposal advertisement in our columns that the notice was seen in Engineering News, which prints a much larger number of reliable news items and is much more extensively read by engineers and contractors than any other paper in America.

YOU are interested in municipal economy and SHOULD use your influence to have your city ADVERTISE work where competition is secured and YOUR contracts can be awarded at low prices. WORK can now be done at a small cost IN this country, if those desiring bids for ENGINEERING supplies or construction will use our NEWS columns to call attention to their work AND will advertise for bids in this paper, and thus SAVE in the cost of advertising and also save MONEY by awarding contracts at low prices.